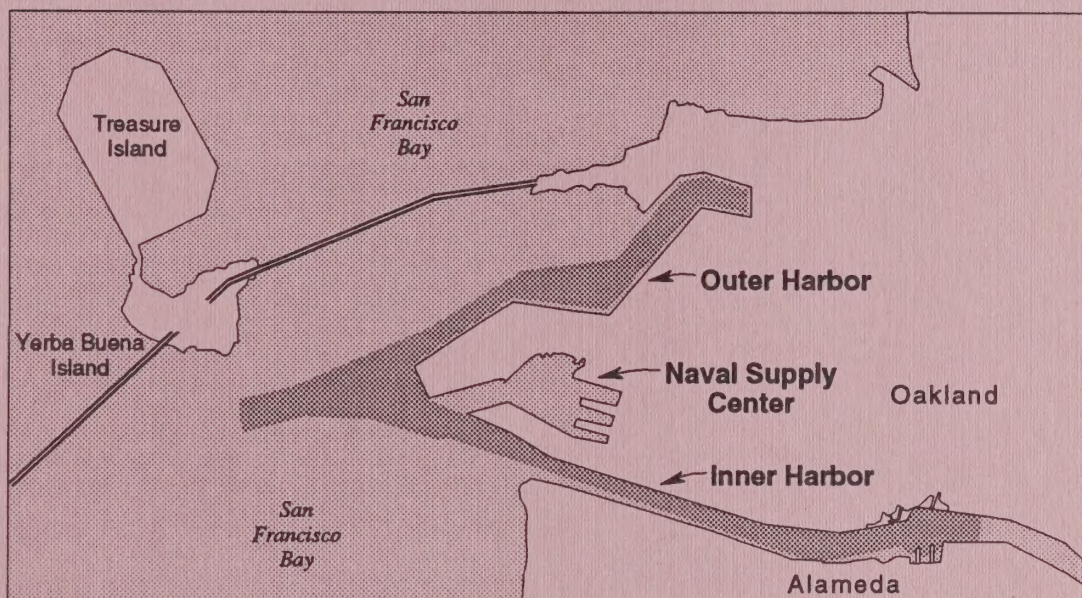


7/12/94

Final Supplemental Environmental Impact Report/ Environmental Impact Statement Oakland Harbor Deep-Draft Navigation Improvements

Appendices A through E and G through L



Prepared by

**U.S. Army Corps of Engineers
San Francisco District**

Federal Lead Agency

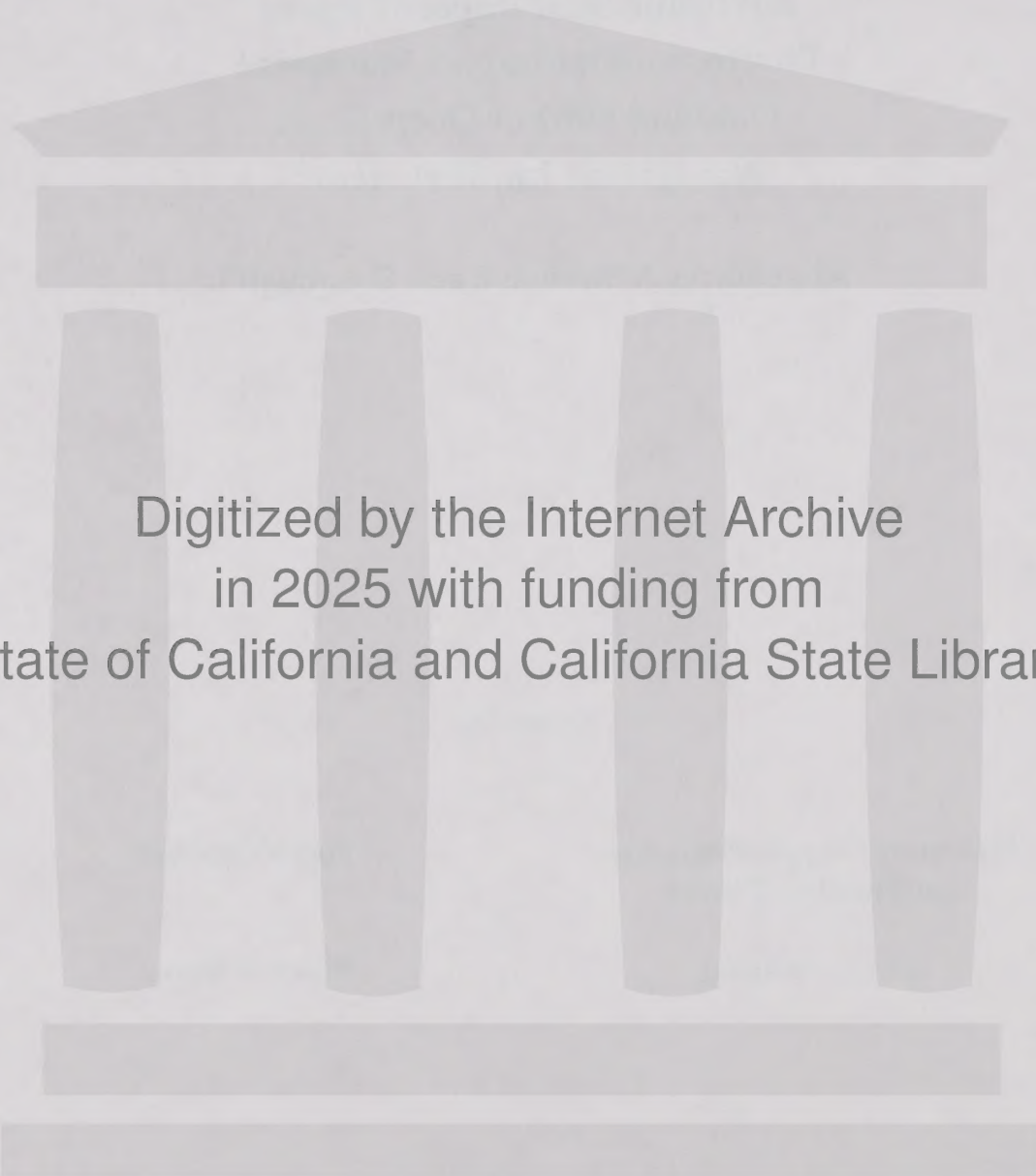
Port of Oakland

State Lead Agency

June 1994

Appendices A through E and G through L

June 1994



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APPENDIX A

SEDIMENT CHARACTERIZATION FOR AQUATIC DISPOSAL

Background Information

Location and Water Quality

APPENDIX A

Sediment Characterization for Aquatic Disposal

The physical and chemical properties of sediments are important factors in determining the fate and transport of contaminants. The physical properties of sediments include grain size, porosity, and permeability. The chemical properties of sediments include pH, organic carbon content, and nutrient levels. The physical and chemical properties of sediments are important factors in determining the fate and transport of contaminants.

Physical Properties

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APPENDIX A

SEDIMENT CHARACTERIZATION FOR AQUATIC DISPOSAL

Environmental Consequences

Sediment and Water Quality

1. Samples of sediments from the Oakland Inner and Outer Harbors, berths not already at Project depth, and the Alcatraz Environs (R-AM) and Deep Off-shore (R-OS) reference sediments. The samples were analyzed for physical and chemical characteristics, and tested for acute toxicity when suspended in the water column and for acute toxicity and bioaccumulation potential when deposited on the bottom.
2. The physical and chemical analyses were: grain size, total volatile solids (TVS), total organic carbon (TOC), oil and grease, total petroleum hydrocarbons (TPH), 10 metals (including EPA priority pollutant metals), 6 low and 10 high molecular weight polycyclic aromatic hydrocarbons (PAH), 3 butyltin compounds, 4 to 7 polychlorinated biphenyls (PCB), and 18 chlorinated pesticides.
3. SEDIMENT CHEMISTRY
4. The following is a summary of the results of the physical and chemical analysis shown in Tables 1, 2 and 3, for full core length sediment samples. The cores and composites with the maximum and minimum values cited are identified in the parentheses.
5. The range of TOC concentrations was 0.02 percent (I-C12) to 1.08 percent (I-C5) in the Inner Harbor (IH) Channel, 0.03 percent (O-C9) to 1.15 percent (O-C6) in the Outer Harbor Channel, 0.01 percent (I-T5) to 1.33 percent (I-T1) in the wings of the IH Turning Basin and 0.02 percent (OB-1c, OB-2e, f, IB-4b) to 1.15 percent (O-C6) in the Berths. The TOC range for R-AM was 0.03 percent to 0.78 percent and for R-OS 0.63 percent to 1.00 percent. Forty-six percent and 20 percent of the TOC concentrations exceeded, respectively, the R-AM and R-OS means (0.24 percent & 0.75 percent).
6. The range of TVS concentrations was 0.34 percent (I-C1-A4) to 8.55 percent (I-C5) in the Inner Harbor Channel, 0.48 percent (O-C4-B2) to 7.41 percent (O-C13) in the Outer Harbor Channel, 1.38 percent (I-T5) to 10.08 percent (I-T1) in the wings of the IH Turning Basin and 0.78 percent (IB-2a) to 5.32 percent (COMP IB-1) in the Berths. The TVS range for R-AM is 0.24 percent to 2.30 percent and for R-OS 2.34 percent to 6.99 percent. Sixty-two percent and 18 percent of the TVS concentrations exceeded, respectively, the R-AM and R-OS means (1.6 percent & 4.6 percent).
7. The range of oil and grease concentrations was <0.60 parts per million (ppm) (I-C14) to 245 ppm (I-C29) in the Inner Harbor Channel, < 12 ppm (O-C4-B1 & 2) to 660 ppm (O-C4-B4) in the Outer Harbor Channel, 15.01 ppm (I-T5) to 344 ppm (I-S1) in the wings of the IH Turning Basin and less than 1.2 ppm (OB-2f, IB-2a, 3a & b, 4a & b) to 363.7 ppm (COMP IB-1) in the Berths. The oil and grease range for R-AM was less than 0.70 ppm to 41 ppm and for R-OS 3.91 ppm to 72 ppm. Seventy-four percent and 54 percent of the oil and

grease concentrations exceeded, respectively, the R-AM and R-OS means (<11.9 ppm & <23.5 ppm) -- not including values at analysis detection limits higher than the means.

8. The range of TPH concentrations was <0.7 ppm (I-C11) to 181 ppm (I-C29) in the Inner Harbor Channel, 3 ppm (O-C9) to 600 ppm (O-C4-B4) in the Outer Harbor Channel, 11.96 ppm (I-T3) to 267 ppm (I-S1) in the wings of the IH Turning Basin and less than 1.1 ppm (OB-1a) to 349.1 ppm (COMP IB-1) in the Berths. The TPH range for R-AM was less than 0.6 ppm to 8 ppm and for R-OS less than 0.9 ppm to 10.10 ppm. Seventy-five percent and 72 percent of the oil and grease concentrations exceeded, respectively, the R-AM and R-OS means (<4.9 ppm & <7.0 ppm) -- not including values at analysis detection limits higher than the means. Sediment samples with the highest TPH concentrations also had the highest oil and grease concentrations.
9. The range of silver (Ag) concentrations was 0.026 ppm (I-C1-A4) to 0.87 ppm (I-C29) in the Inner Harbor Channel, 0.027 ppm (O-C4-B2) to 0.603 ppm (O-C4-B4) in the Outer Harbor Channel, 0.026 ppm (I-T5) to 0.629 ppm (I-T1) in the wings of the IH Turning Basin and less than 0.010 ppm (IB-3a) to 0.519 ppm (COMP IB-1) in the Berths. The range for R-AM was 0.015 ppm to 0.048 ppm and for R-OS 0.190 ppm to 0.390 ppm. Eighty-six percent and 17 percent of the silver concentrations exceeded, respectively, the R-AM and R-OS means (0.032 ppm & 0.293 ppm).
10. The range of arsenic (As) concentrations was less than 1.40 ppm (I-C11) to 13.2 ppm (I-C1-C4) in the Inner Harbor Channel, 1.65 ppm (O-C9) to 12.4 ppm (O-C8) in the Outer Harbor Channel, 3.12 ppm (I-T5) to 12.93 ppm (I-T1) in the wings of the IH Turning Basin and 2.15 ppm (OB-2f) to 8.20 ppm (COMP IB-1) in the Berths. The range for R-AM was 5.83 ppm to 13.20 ppm and for R-OS 3.88 ppm to 5.33 ppm. Thirty-five percent and 55 percent of the arsenic concentrations exceeded, respectively, the R-AM and R-OS means (8.5 ppm & 4.3 ppm).
11. The range of cadmium (Cd) concentrations was 0.03 ppm (I-C7) to 0.99 ppm (I-C29) in the Inner Harbor Channel, 0.08 ppm (O-C9) to 0.60 ppm (O-C13) in the Outer Harbor Channel, 0.09 ppm (I-T5) to 0.76 ppm (I-S1) in the wings of the IH Turning Basin and 0.03 ppm (IB-3a) to 0.39 ppm (COMP IB-1) in the Berths. The range for R-AM was 0.04 ppm to 0.09 ppm and for R-OS 0.31 ppm to 0.57 ppm. Ninety-three percent (not including values at analysis detection limits > 0.06 ppm) and 7 percent of the cadmium concentrations exceeded, respectively, the R-AM and R-OS means (0.06 ppm & 0.400).
12. The range of chromium (Cr) concentrations was 140 ppm (I-C18) to 977 ppm (I-C10) in the Inner Harbor Channel, 175 ppm (O-C1) to 531 ppm (O-C5) in the Outer Harbor Channel, 204 ppm (I-S1) to 687 ppm (I-T3) in the wings of the IH Turning Basin and 141 ppm (IB-3a) to 823 ppm (IB-3b) in the Berths. The range for R-AM was 113 ppm to 190 ppm and for R-OS 192 ppm to 255 ppm. Ninety-eight percent and 77 percent of the chromium concentrations exceeded, respectively, the R-AM and R-OS means (143 ppm & 226 ppm).
13. The range of copper (Cu) concentrations was 8.8 ppm (I-C1-A3) to 84.9 ppm (I-C5) in the Inner Harbor Channel, 10.3 ppm (O-C4-B2) to 70.1 ppm (O-C8) in the Outer Harbor Channel, 14.5 ppm (I-T5) to 86.1 ppm (I-S3) in the wings of the IH Turning Basin and 9.1 ppm (IB-3a) to 53.1 ppm (COMP IB-1) in the Berths. The range for R-AM was 7.9 ppm to 12.4 ppm and for R-OS 20.3 ppm to 27.0 ppm. Eighty-eight percent and 50 percent of

the copper concentrations exceeded, respectively, the R-AM and R-OS means (11.0 ppm & 23.0 ppm)

14. The range of mercury (Hg) concentrations was 0.007 ppm (I-C7) to 1.280 ppm (I-C29) in the Inner Harbor Channel, 0.020 ppm (O-C4-B2) to 0.490 ppm (O-C6) in the Outer Harbor Channel, 0.031 ppm (I-T5) to 0.812 ppm (I-S1) in the wings of the IH Turning Basin and 0.003 ppm (IB-2a, 4b) to 0.330 ppm (COMP IB-1) in the Berths. The range for R-AM was 0.009 ppm to 0.057 ppm and for R-OS 0.058 ppm to 0.217 ppm. Eighty-four percent and 35 percent of the copper concentrations exceeded, respectively, the R-AM and R-OS means (0.037 ppm & 0.106 ppm).
15. The range of nickel (Ni) concentrations was 29.3 ppm (I-C1-C3) to 125.5 ppm (I-C9) in the Inner Harbor Channel, 53.6 ppm (O-C4-B2) to 115.7 ppm (O-C6) in the Outer Harbor Channel, 62.9 ppm (I-T3) to 132.8 ppm (I-S1) in the wings of the IH Turning Basin and 43.6 ppm (IB-3a) to 93.8 ppm (COMP IB-1) in the Berths. The range for R-AM was 33.5 ppm to 51.8 ppm and for R-OS 63.5 ppm to 75.1 ppm. Ninety-three percent and 51 percent of the nickel concentrations exceeded, respectively, the R-AM and R-OS means (41.4 ppm & 68.9 ppm).
16. The range of lead (Pb) concentrations was 4.9 ppm (I-C4) to 63.5 ppm (I-C29) in the Inner Harbor Channel, 3.8 ppm (O-C4-B1) to 49.8 ppm (O-C7) in the Outer Harbor Channel, 5.3 ppm (I-T5) to 65.3 ppm (I-S1) in the wings of the IH Turning Basin and 5.4 ppm (IB-2a) to 36.4 ppm (COMP IB-1) in the Berths. The range for R-AM was 11.0 ppm to 15.2 ppm and for R-OS 6.8 ppm to 9.6 ppm.

Thirty-eight percent and 71 percent of the lead concentrations exceeded, respectively, the R-AM and R-OS means (13.7 ppm & 8.1 ppm).

17. The range of selenium (Se) concentrations was less than 0.07 ppm (I-C3, 7, 10, 11, 12, 17, 18) to 0.35 ppm (I-C1-B4) in the Inner Harbor Channel, less than 0.11 ppm (BC-5, 8, O-C3, 5, 9) to 0.30 ppm (O-C7) in the Outer Harbor Channel, less than 0.07 ppm (I-T3) to 0.38 ppm (I-S1) in the wings of the IH Turning Basin and less than 0.12 ppm (OB-1b, 2a, c, d, f, 3c, COMP OB-3, IB-2a, 3b) to 0.27 ppm (IB-3a) in the Berths. The range for R-AM was below analysis detection limits, varying from less than 0.08 to less than 0.22 ppm, and for R-OS 0.56 ppm to 1.21 ppm. Thirty-six percent of the selenium values exceed analysis detection limits or the R-AM mean (<0.13 ppm) and none exceed the R-OS mean (0.89 ppm).
18. The range of zinc (Zn) concentrations was 24.5 ppm (I-C1-A4) to 216 ppm (I-C1-B4) in the Inner Harbor Channel, 33.3 ppm (O-C4-B2) to 175 ppm (O-C8) in the Outer Harbor Channel, 43.5 ppm (I-T5) to 222.0 ppm (I-S1) in the wings of the IH Turning Basin and 26.4 ppm (IB-3a) to 133.4 ppm (COMP IB-1a) in the Berths. The range for R-AM was 32.0 ppm to 36.8 ppm and for R-OS 76.3 ppm to 91.4 ppm. Ninety-one percent and 36 percent of the zinc concentrations exceeded, respectively, the R-AM and R-OS means (34.8 ppm & 84.2 ppm).
19. The range of total low molecular weight polycyclic aromatic hydrocarbons (LPAH) concentrations was from below analysis detection limits (I-C3, 7-9, 11, 14-18) to 0.836 ppm (I-C1-B3) in the Inner Harbor Channel, 0.006 ppm (O-C5) to 0.276 ppm (O-C8) in the Outer Harbor Channel, from below analysis detection limits (I-T5) to 0.606 ppm (I-S1) in the

wings of the IH Turning Basin and 0.001 ppm (OB-1a, c, 2e, f, IB-2a, 3a) to 0.742 ppm in the Berths. The range for R-AM was 0.013 ppm to 1.372 ppm and for R-OS 0.005 ppm to 0.065 ppm. Five percent and 62 percent of the LPAH concentrations above analysis detection limits exceeded, respectively, the R-AM and R-OS means (0.393 ppm & <0.023 ppm).

20. The range of total high molecular weight polycyclic aromatic hydrocarbons (HPAH) concentrations was from below analysis detection limits (I-C3, 7-9, 11, 14-16, 18) to 3.508 ppm (I-C29) in the Inner Harbor Channel, from below analysis detection limits (O-C9) to 2.552 ppm (O-C4-A) in the Outer Harbor Channel, from below analysis detection limits (I-T5) to 5.773 ppm (I-S1) in the wings of the IH Turning Basin and from below analysis detection limits (OB-1a, 2e, f, IB-2a) to 3.109 ppm in the Berths. The range for R-AM was 0.021 ppm to 3.757 ppm and for R-OS from below analysis detection limits to 0.057 ppm. Twenty-seven percent of the HPAH concentrations exceeded the R-AM mean (1.126 ppm) and 71 percent exceed analysis detection limits or the R-OS mean (<0.021 ppm).
21. The range of total polycyclic aromatic hydrocarbons (TPAH) concentrations was from below analysis detection limits (I-C3, 7-9, 11, 15, 16, 18) to 3.956 ppm (I-C1-B3) in the Inner Harbor Channel, from below analysis detection limits (O-C9) to 3.047 ppm (O-C4-A) in the Outer Harbor Channel, from below analysis detection limits (I-T5) to 6.379 ppm (I-S1) in the wings of the IH Turning Basin and from 0.001 ppm (OB-1a, 2e, f, IB-2a) to 3.457 ppm (COMP I-B1) in the Berths. The range for R-AM was 0.034 ppm to 5.129 ppm and for R-OS from below analysis detection limits to 0.122 ppm. Twenty-one percent of the TPAH concentrations exceeded the R-AM mean (1.518 ppm) and 73 percent exceed analysis detection limits or the R-OS mean (<0.040 ppm).
22. The range of tributyltin (TBT) concentrations was 0.006 ppm (I-C16) to 0.0404 ppm (I-C9) in the Inner Harbor Channel, from less than 0.0007 ppm (I-C4-B1, 2) to 0.0091 ppm (O-C13) in the Outer Harbor Channel, from less than 0.001 ppm (I-T5) to 0.0643 ppm (I-T3) in the wings of the IH Turning Basin and from 0.006 ppm (OB-1a) to 0.0273 ppm (COMP I-B1) in the Berths. The range for R-AM was from less than 0.007 ppm to 0.0011 ppm and for R-OS from less than 0.007 ppm to 0.0019 ppm. Sixty-seven percent and 63 percent of the TBT concentrations exceeded, respectively, the R-AM and R-OS means (<0.0009 ppm & <0.0011 ppm) and analysis detection limits.
23. The range of dibutyltin (DBT) concentrations was from less than 0.0004 ppm (I-C18) to 0.019 ppm (I-C29) in the Inner Harbor Channel, from less than 0.001 ppm (O-C2, 3, 9) to 0.0099 ppm (O-C7) in the Outer Harbor Channel, from less than 0.001 ppm (I-T5) to 0.0058 ppm (I-T1) in the wings of the IH Turning Basin and from less than 0.0004 ppm (OB-1a) to 0.0084 ppm (COMP I-B1) in the Berths. The range for R-AM was from less than 0.0006 ppm to 0.0016 ppm and for R-OS from less than 0.0007 ppm to 0.0015 ppm. Forty-nine percent of the DBT concentrations exceeded both the R-AM and R-OS means (<0.0010 ppm & <0.0011 ppm, respectively) and analysis detection limits.
24. The range of monobutyltin (MBT) concentrations was from less than 0.0003 ppm (I-C17) to 0.006 ppm (I-C29) in the Inner Harbor Channel, from less than 0.00065 ppm (COMP AC-3) to 0.0048 ppm (O-C6) in the Outer Harbor Channel, from less than 0.001 ppm (I-T5) to 0.0058 ppm (I-S1) in the wings of the IH Turning Basin and from less than 0.0004 ppm (OB-1a, c, OB-3b, IB-1a, IB-3a) to 0.0089 ppm (COMP I-B2) in the Berths. The range for R-AM was from less than 0.0005 ppm to 0.001 ppm and for R-OS from less than 0.0008

ppm to 0.0125 ppm. Thirty-eight percent and 8 percent of the MBT concentrations exceeded, respectively, the R-AM and R-OS means (<0.0009 ppm & <0.0033 ppm) and analysis detection limits.

25. The range of polychlorinated biphenyl (PCB) concentrations was from less than analysis detection limits of 0.0028 ppm (most Comps I-C1-A, I-C1-B & I-C1-C holes) to 0.387 ppm (I-C29) in the Inner Harbor Channel, from less than 0.0028 ppm (O-C4-B1, 2) to 0.433 ppm (O-C4-B4) in the Outer Harbor Channel, from less than 0.020 ppm (I-T5) to 0.400 ppm (I-T3) in the wings of the IH Turning Basin and from less than 0.020 ppm (COMP OB-1, OB-1a-c, COMP OB-2, OB-2a, b, d-f, 3c, IB-2a, COMP IB-3, IB-3a, b, 4a, b) to 0.241 ppm (COMP I-B1) in the Berths. All R-AM concentrations were less than analysis detection limits, ranging from 0.0028 to 0.025 ppm, and for R-OS from less than 0.0028 ppm to 0.260 ppm. Thirty-one percent and 13 percent of the PCB concentrations exceeded, respectively, the R-AM and R-OS means (<0.0184 ppm & <0.0656 ppm) and analysis detection limits.
26. Concentrations of the chlorinated pesticides 4,4'DDD, 4,4'DDE and 4,4'DDT were higher than analysis detection limits in 21 percent of the Inner Channel samples, 25 percent of the Outer Channel samples, none of the IH turning basin wing samples, and 58 percent of the berth samples. The maximum total of DDD, DDE, DDT concentration was 0.0122 ppm (I-C29) in the Inner Harbor Channel, 0.0221 ppm (O-C4-B4) in the Outer Harbor Channel, and 0.0064 ppm (IB-1b) in the Berths. The maximum R-AM concentration, above analysis detection limits, was 0.0007 ppm and for R-OS 0.0012 ppm. Twelve percent and 14 percent of the total concentrations exceeded, respectively, the R-AM and R-OS means (<0.0036 ppm & <0.0031 ppm) and analysis detection limits.
27. Concentrations of the other chlorinated pesticides were higher than analysis detection limits in 61 percent of the Inner Channel samples, 13 percent of the Outer Channel samples, none of the IH turning basin wing samples, and 85 percent of the berth samples. The maximum concentration was 0.0053 ppm (I-C5) of Dieldrin in the Inner Harbor Channel, 0.0081 ppm (O-C8) of Endrin in the Outer Harbor Channel, and 0.0028 ppm (COMP IB-3) of Endosulfan sulfate in the Berths. The only non-DDT related chlorinated pesticides found in the reference sediments, at concentrations above analysis detection limits, were 0.0005 ppm of Heptachlor epoxide in R-AM and 0.0004 ppm of Gamma BHC and 0.0007 ppm of Alpha BHC in R-OS. Ten percent and 8 percent, respectively, of the Project samples had a concentration of some non-DDT related chlorinated pesticide exceeding the R-AM and R-OS maxima.
28. The undisturbed Older Bay Mud (OBM) and Merritt Formation materials lying below the Young Bay Mud (YBM) were deposited more than 10,000 years ago and, therefore, contain no contaminants of human origin. A prehistoric deposit of undisturbed YBM also fills an ancient stream channel in the Inner Harbor. Thirteen samples of undisturbed OBM and Merritt formation materials were analyzed in the -42' Project sediment analysis program (OB1a, c, IB2a, & IB3b in the Battelle Berths report; CH4, MS-1, MS-1 Dup, MS-2 in the Battelle Phase I report: OI-CH-1, OI-CH-4A, OI-CH-6A, OO-W-5, OI-TS-5 Merritt in the Battelle Phase II report). None showed concentrations of naturally occurring substances (refer to Table 10) that would be a cause for concern if disposed in the Bay or ocean. In 1993 Pelagos Corporation used subbottom profiling techniques to map the depth and distribution and calculate the volume of sediments that remain undisturbed in Berths 25, 32, 33, 34, 60, 61, 62 and 63 and in the areas represented by sampling stations IC-8 through 17 and IC 29 and 30.

29. According to "Green Book" guidelines, the results of sediment chemistry analyses are not to be used for determining the suitability of sediments for unconfined aquatic disposal. They are to provide a basis for determining which contaminant concentrations in sediment treatments might be responsible for the biological effects seen in toxicity tests. Biological toxicity and bioaccumulation test results on sediments are used to evaluate appropriate dredged sediment disposal alternatives and for drawing boundaries around sediments suitable for aquatic disposal.

30. BIOLOGICAL EFFECTS TESTS

- (1) To evaluate potential biological effects while dredged materials are in the water column, suspended particulate phase (SPP) bioassay tests were conducted using the mysid shrimp (*Holmesimysis sculpta*), juvenile speckled sanddab (*Citharichthys stigmaeus*), and larvae of the Pacific oyster (*Crassostrea gigas*), or blue mussel (*Mytilus edulis*).
- (2) To evaluate potential acute toxicity effects of redeposited dredge sediments, 10-day exposure solid phase (SP) tests were conducted using the detrital-feeding bentnose clam (*Macoma nasuta*), the burrowing, deposit-feeding polychaete worm (*Nephtys caecoides*), the bottom-dwelling flatfish (*Citharichthys stigmaeus*), and the burrowing, detrital-feeding amphipod (*Rhepoxynius abronius*). Twenty-eight day exposures of *Macoma* and *Nephtys* were also conducted as part of the bioaccumulation tests.
- (3) To evaluate the potential for bioaccumulation, *Macoma* and *Nephtys* were exposed to solid phase dredge sediments for 28 days and the concentration of contaminants of concern were measured in their tissues.

31. ACUTE TOXICITY

The results of the acute toxicity tests are summarized in Table A-4 and discussed below.

32. The significance of potential biological effects indicated by SPP test results are not determined by comparison to the results from reference sediment tests. The results of SPP exposures are used to calculate the concentration of suspended sediments that would be lethal to 50 percent (LC50) of the organisms during the test exposure period. The LC50 is not the criteria used to determine suitability for aquatic disposal. It is used, in a mathematical model of the mixing that will occur in a specified period at the disposal site, to determine the concentration of suspended sediments that will not produce more than 1 percent mortality -- the Limiting Permissible Concentration (LPC). Experience calculating hundreds of LPCs for dredge materials has shown that LC50s must be very low, below 15 percent, before the LPC calculation may indicate a sediment is not suitable for aquatic disposal.
33. Four of the 21 Inner Harbor Channel SPP tests produced calculable LC 50s -- 49.0 percent, 76.4 percent, 79.9 percent and 91.9 percent. The first 3, for Composites I-C1-B and I-C1-B Special, were shown to be due to ammonia toxicity, not contaminants of concern. None of the 15 Outer Harbor Channel SPP tests showed acute toxicity. No SPP tests were done on sediments in the wings of the IH turning basin. Five of the 12 SPP tests on berth sediments produced calculable LC50s -- 31.5 percent, 58.4 percent, 65.1 percent, 65.3 percent and 87.5 percent. The results of the SPP tests indicate that none of the channel sediments would have a significant toxic effect on water column biota. Any contaminants that might cause SPP toxicity in sediments to be removed from the berths and turning basin wings are

confined to the Younger Bay Mud (YBM) deposits -- materials that will be disposed at upland site(s). Ninety-four percent of Composite OB-1 was undisturbed Merritt sands, and the SPP test on it showed a LC50 of greater than 100 percent -- indicating that aquatic disposal would have no significant toxic effects on water column biota. The IB2a and IB3b cores were all undisturbed Merritt sands. However, they were included in Comp IB-SPP for SPP testing and it was only 63 percent undisturbed Merritt Formation materials.

34. The "Green Book" specifies that 2 SP test criteria must be met before a sediment can be considered unsuitable for aquatic disposal. Both involve comparisons of SP test results relative to the survival of test organisms in concurrent exposures to reference sediments. Reference sediments (R-OS and R-AM) are chosen to have essentially the same characteristics as those found on the bottom at potential disposal sites, before any disposal has occurred. The first criterion requires a statistical comparison (Dunnett's Test) of the variability of survival in replicated exposures to determine if differences are statistically significantly. If they are, the second criterion requires that the survival rates in the sediments to be dredged be less than specified amounts below survival in the reference sediments.
35. According to "Green Book" criteria, acute toxicity effects on *Rhepoxynius* (and all other amphipods) of more than 20 percent below those observed in reference sediments indicate material that is unsuitable for aquatic disposal. For all the other test species, 10 percent is the significant effects threshold. The apparently, less stringent threshold for *Rhepoxynius* is to account for the degree of variability expected due to non-contaminant related effects when testing sediments that have a range of grain sizes, organic carbon content, etc. The sediments in which the *Rhepoxynius* collected for testing this Project's sediments naturally live contain only 2 percent silt and clay (Battelle IIIB). The results of 28-day tests can be useful for making a determination when problems (such as outliers in replicates) occur in the 10-day tests or when they are inconclusive.
36. In Inner Harbor Channel sediments, the clam *Macoma* 10-day SP test exposures resulted in survival rates ranging from 88 percent to 100 percent -- none of them statistically significantly different from survival rates in the R-OS and R-AM sediments. The 10-day SP test survival rates for the worm *Nephtys* ranged from 31 percent to 100 percent, in sediments that will be dredged by this Project. The Project no longer extends as far as the sediments characterized by treatment I-C18 and will include only half the sediments characterized by I-C15, 16, and 17. The worm mortality in the latter three was statistically significantly lower and more than 10 percent below the R-OS and R-AM values in those sediments. The 81 percent survival rate for Comp I-C1-B Special is statistically significantly lower and more than 10 percent below the R-OS and R-AM values. However, the 28-day SP test survival for *Nephtys* was 87 percent, higher than the 10 percent threshold for R-OS and R-AM values. Additional tests (Battelle 11/93) showed that this relatively low survival rate was due to ammonia toxicity, not due to contaminants of concern. In this case, the ammonia levels found in the bioassay chambers would not be expected to persist in the environment on or following disposal of the sediments at an aquatic disposal site. The ammonia levels noted would be quickly -- nearly instantaneously -- stripped from the sediment on exposure to the oxygenated water column during the disposal event itself. The *Rhepoxynius* test results were not considered in determining the suitability of this sediment for aquatic disposal. The survival rates for 5 (I-C8, 10, 11 12 & 14) additional samples of sediments to be dredged were statistically significantly lower and more than 10 percent below the R-AM value. However, the 28-day survival rates for I-C10 (84.6 percent) and I-C14 (83.4 percent) were

less than 10 percent below the 28-day R-OS (92.6 percent) rate. The survival rates for the 10-day SP toxicity test on the amphipod *Rhepoxynius* ranged from 26 percent to 96 percent. The survival rates for 4 of the 21 samples of sediments to be dredged were both statistically significantly lower and more than 20 percent below the R-OS value. However, additional tests and analyses showed that the low survival rates in COMP-I-C1-B and COMP I-C1-B Special were due to the effects of ammonia toxicity and low salinity waters in the sediments, not due to contaminants of concern. Consequently, the *Rhepoxynius* test results were not considered in determining the suitability of those 2 sediments for aquatic disposal. The survival rates for 5 of the 21 samples were both statistically significantly lower and more than 20 percent below the R-AM value. The survival rates for the 10-day SP toxicity test on the juvenile fish *Citharichthys* ranged from 85 percent to 100 percent -- none statistically significantly lower or more than 10 percent below the R-OS and R-AM values.

37. In Outer Harbor Channel sediments, the only *Macoma* 10-day SP test had a 99 percent survival rate. However, the 14 28-day exposures resulted in survival rates ranging from 94 percent to 100 percent. The 10-day SP test survival rates for *Nephtys* ranged from 82 percent to 99 percent. Four test results (O-C13, O-C11, O-C7, O-C1) were statistically significantly lower and more than 10 percent below the R-OS and R-AM values. However, the 28-day survival rates for O-C7 (92 percent) and O-C1 (91.8 percent) were less than 10 percent below the 28-day R-OS (92.7 percent) and R-AM (99.3 percent) rates. The survival rates for the 10-day SP toxicity test on the amphipod *Rhepoxynius* ranged from 47 percent to 98 percent. The survival rate for 1 (O-C1) of the 14 samples was both statistically significantly lower and more than 20 percent below the R-OS value and 4 (O-C12, O-C9, O-C1 and O-C2) below the R-AM value. The survival rates for the 10-day SP toxicity test on the juvenile fish *Citharichthys* ranged from 94 percent to 100 percent -- none statistically significantly lower or more than 10 percent below the R-OS and R-AM values.
38. In the wing sediments, of the Inner Harbor turning basin, the 10-day SP test survival rates for *Macoma* ranged from 96 percent to 100 percent -- none statistically significantly lower or more than 10 percent below the R-OS and R-AM values. The 28-day test survival rates ranged from 93 percent to 98.4 percent. The 10-day SP test survival rates for *Nephtys* ranged from 57 percent to 93 percent and the 28-day test rates from 67 percent to 92.7 percent. One 10-day result (I-T3) was statistically significantly lower or more than 10 percent below the R-OS and R-AM values and 2 more (I-S1 & I-T1) lower and below only the R-AM value. The survival rates for the 10-day SP toxicity test on the amphipod *Rhepoxynius* ranged from 71 percent to 89 percent. The survival rate for 1 (I-S1) of the 4 samples was both statistically significantly lower and more than 20 percent below the R-AM value, but none were relative to the R-OS value. The survival rates for the 10-day SP toxicity test on the juvenile fish *Citharichthys* ranged from 90 percent to 95 percent -- none statistically significantly lower or more than 10 percent below the R-OS and R-AM values.
39. In the berth sediments, the 10-day SP test survival rates for *Macoma* ranged from 98 percent to 100 percent -- none statistically significantly lower or more than 10 percent below the R-OS and R-AM values. The 28-day test survival rates ranged from 92 percent to 98.4 percent. The 10-day SP test survival rates for *Nephtys* ranged from 73 percent to 96 percent and the 28-day test rates from 77.3 percent to 94.7 percent. Two of the 6 10-day results (Comp IB-2 & 3) were statistically significantly lower or more than 10 percent below the R-OS value and none lower and below the R-AM value. The 28-day survival rate for Comp IB-2 was 90.0 percent, less than 10 percent below the 28-day R-OS (92.7 percent) and R-AM (96 percent) rates. The survival rates for the 10-day SP toxicity test on the amphipod

Rhepoxynius ranged from 72 percent to 90 percent -- none statistically significantly lower or more than 20 percent below the R-OS and R-AM values. The survival rates for the 10-day SP toxicity test on the juvenile fish *Citharichthys* ranged from 96 percent to 98 percent -- none statistically significantly lower or more than 10 percent below the R-OS and R-AM values.

40. BIOACCUMULATION

41. The results of bioaccumulation tests are summarized in Tables 5 and 6 and discussed below. Bioaccumulation by the two test species is an indicator of potential bioavailability of sediment-borne contaminants to other species that may be exposed to the sediments at the disposal site.
42. The "Green Book" does not specify numerical suitability criteria for interpreting the biological significance of bioaccumulation test results. The statistical analysis comparison must again be used to determine if the differences between the amount of bioaccumulation in dredge and reference sediments are statistically significant -- given the variability of results in replicated exposures. A second criterion requires that statistically significantly greater tissue concentrations not exceed the health standards set by the Food and Drug Administration for safe human consumption. Application of FDA standards to test organism burden levels is a conservative approach because the test species are not directly consumed by humans. Moreover, for those compounds that do not actually biomagnify (and most compounds in fact do not), this approach is even more protective to human health. The remaining "Green Book" guidelines are descriptive rather than numerical, because there is no established ecological significance of differing concentrations of bioaccumulated contaminants in marine, aquatic organisms.
43. Consequently, best professional judgment must often be used to make bioaccumulation-based suitability determinations. Best professional judgment utilizes qualitative and quantitative considerations to guide decisions about the suitability of dredged materials for aquatic disposal. Such considerations include: relative concentrations in tissues exposed to project sediments compared to in tissues exposed to reference sediments; whether one or both species bioaccumulated; how many chemicals bioaccumulated, the seriousness of the health hazard posed by bioaccumulating chemicals -- particularly known human carcinogens; adjustments for testing problems (e.g., one replicate greatly different than the others); apparently high bioaccumulations that are artifacts of comparing concentrations below differing analysis detection limits; bioaccumulations large relative to reference sediments (particularly when the latter are below analysis detection limits) but representing low absolute tissue concentrations; and relative concentrations in tissues of organisms exposed to project sediments compared to FDA action levels for safe human consumption. A decisionmaking framework (DMF) has been developed by Lee et al. (1991) which describes the procedures to be followed in the interpretation of test results.
44. To facilitate comparisons, tissue concentrations are expressed as multiples (e.g., 3.2x) of those found in the organisms kept in the reference sediments.
45. The test organisms have a variable natural ability to bioaccumulate chemicals because of the genetic variability that exists in wild-caught specimens. A magnitude of bioaccumulation no more than the variability of tissue concentrations observed to occur in a wild-caught specimens exposed to appropriately clean reference sediments, kept under test conditions, is

not considered to be significant. Natural, bioaccumulation magnitude differences of about 2.0x of metals are commonly observed within a species in bioaccumulation tests (J. Word 1992 personal communication).

46. None of the statistically significant tissue concentrations in test organisms grown in Project sediments exceeded the FDA standards for safe human consumption.
47. Table 5, for R-OS, and Table 6, for RAM, contain the bioaccumulation test results summarized into four categories: statistically significant, 2-5x, 5-10x, and > 10x.
48. 10x Bioaccumulation
49. In Outer Harbor Channel sediments, bioaccumulation of 10x or more was observed for: metals in *Nephtys* (O-C8 relative to R-OS & O-C4A relative to R-OS and R-AM and in Comp OC4-B relative to R-OS); a HPAH in *Nephtys*; and a PCB in *Macoma*.
50. In Inner Harbor Channel sediments, bioaccumulation of 10x or more was observed for HPAHs in both species relative to both references (I-C10), in *Macoma* (I-C15 relative to R-OS), and in *Nephtys* (I-C12 relative to R-OS & R-AM and Comp III [containing I-C29 & 30] relative to R-AM).
51. In Turning Basin Wing sediments, bioaccumulation of 10x or more was observed for: one LPAH in *Macoma* (I-S1 relative to R-AM); HPAHs in both species relative to both references (I-S1 & I-T3) and in *Macoma* relative to both references (I-T1 & I-T5); and butyltins in *Macoma* (relative to R-OS) and in *Nephtys* (relative to R-OS and R-AM).
52. In berth sediments, bioaccumulation of 10x or more was observed for: HPAHs in both species relative to both references (Comps OB-2, OB-3, IB-1, IB-2, IB-3); only in *Macoma* (Comp OB-1 relative to R-OS); and only in *Nephtys* (Comps OB-3, IB-1, IB-3 relative to R-AM); pesticides in *Nephtys* (Comps OB-1 & OB-2 relative to R-AM); PCBs in *Macoma* (Comp IB-1 relative to R-OS), and in *Nephtys* (Comps OB-3, IB-1, IB-2, & IB-3 relative to both references); and a butyltin in *Nephtys* (Comp IB-2 relative to R-OS).
53. 5-10x Bioaccumulation
54. In Outer Harbor Channel sediments, bioaccumulation of 5 to 10x was observed for: HPAH in *Macoma* (O-C13, O-C11 & Comp O-C4-B relative to R-OS) and in *Nephtys* (O-C13 relative to R-OS and R-AM); and metals in *Macoma* (O-C1 relative to R-AM) and in *Nephtys* (O-C10 relative to R-OS and O-C4A relative to both references).
55. In Inner Harbor Channel sediments, bioaccumulation of 5 to 10x was observed for: HPAHs in *Macoma* (I-C8, I-C10, I-C11 & I-C18 relative only to R-OS and I-C10, I-C15 and Comp III [containing I-C29 & 30] relative to R-AM) and in *Nephtys* (I-C9 relative to R-OS); and metals in *Macoma* (I-C9 relative to R-AM).
56. In Turning Basin Wing sediments, bioaccumulation of 5 to 10x was observed for: one LPAH in *Macoma* (I-T3 relative to R-AM); HPAHs in both species relative to both references (I-S1), in *Macoma* (I-T1 & Comp III [containing I-C29 & I-C30] relative to R-AM and I-T3 & I-T5 relative to both references); and butyltins in *Macoma* (I-T3 relative to R-OS and I-T5 relative to R-AM).

57. In berth sediments, bioaccumulation of 5 to 10x was observed for: LPAHs in both species relative to both references (Comp OB-3); HPAHs in both species (Comp OB-3 relative to R-OS & Comps OB-3, IB-1, IB-2 & IB-3 relative to R-AM), and in *Macoma* relative to R-OS (Comps IB-1 & IB-2); pesticides in *Macoma* (Comps IB-2 & IB-3); PCBs in *Macoma* (Comps OB-3, IB-2 & IB-3 relative to R-OS) and in *Nephtys* (Comp OB-2 relative to both references); and butyltins in *Macoma* (Comps OB-3 & IB-3 relative to R-OS) and in *Nephtys* (Comps OB-1 relative to R-OS, OB-3 relative to both references and IB-2 relative to R-AM).
58. 2-5x Bioaccumulation
59. In Outer Harbor Channel sediments, bioaccumulation of 2 to 5x was observed for: LPAH in *Macoma* (O-C10, O-C9, O-C6, O-C5, O-C3 & O-C1 relative to R-OS and R-AM) and in *Nephtys* (O-C2 relative to R-OS); HPAHs in both species (O-C13, O-C10, & O-C8 relative to R-OS and O-C13 relative to R-AM), in *Macoma* relative only to R-OS (O-C7, O-C6 & Comp OC4-B), in *Nephtys* relative to both references (O-C11) and relative only to R-AM (O-C10 & O-C8); PCBs in both species (Comp OC4-B relative to R-AM) and in *Nephtys* relative to R-OS (Comp O-C4-B); metals in both species (O-C13 relative to R-OS), in *Macoma* relative to R-OS (O-C1 & Comp OC4-B) and relative to R-AM (OC-12, O-C8, O-C3, O-C2 & O-C1), in *Nephtys* relative to both references (O-C11 & O-C4A), relative only to R-OS (O-C13, O-C7, O-C6, O-C5) and relative only to R-AM (O-C12 & O-C10); and butyltin in *Macoma* relative to R-OS (Comp OC4-B).
60. In Inner Harbor Channel sediments, bioaccumulation of 2 to 5x was observed for: LPAH in *Nephtys* relative to R-OS (I-C3, I-C, I-C5, I-C7, I-C8, I-C9, I-C12, I-C15, I-C16, & I-C18); HPAHs in *Macoma* relative to both references (I-C10, Comp IC1-B Special & Comp IC1-C) and relative only to R-OS (I-C7), in *Nephtys* relative to both references (I-C8, I-C15 & I-C17) and relative only to R-AM (I-C9); pesticides in *Nephtys* (Comp IC1-A relative to R-OS); metals in both species (I-C18 relative to R-AM), in *Macoma* relative to both references (I-C2, I-C9, I-C10, I-C11, I-C14 & I-C17), relative only to R-OS (I-C3, I-C4, I-C5, I-C7, I-C8, I-C12, I-C15 & I-C16), relative only to R-AM (Comps IC1-A, IC1-B, IC1-B Special, IC1-C, & III [containing IC29 & IC30]) and in *Nephtys* relative only to R-OS (I-C4, I-C18 & Comp IC1-B Special); butyltins in both species (I-C11 relative to R-OS), in *Macoma* relative to R-OS (IC1-B Special), in *Nephtys* relative to both references (I-C15 & I-C18), and relative to R-AM (I-C11).
61. In Turning Basin Wing sediments, bioaccumulation of 2 to 5x was observed for: LPAHs in *Nephtys* relative to both references (I-S1), and relative only to R-OS (I-T1 & I-T3); HPAHs in both species relative to both references (I-T1 & I-T3), in *Macoma* relative to both references (I-T5); PCB in *Nephtys* relative to R-AM (I-T3); metals in *Macoma* relative to both references (I-S1 & I-T3) and relative only to R-AM (I-T1 & I-T5), and in *Nephtys* relative only to R-OS (I-T1 & I-T3); and butyltins in *Macoma* (I-T5 relative to R-OS & I-T3 relative to R-AM) and in *Nephtys* (I-T3 relative to R-OS).
62. In berth sediments, bioaccumulation of 2 to 5x was observed for: LPAHs in both species relative to both references (Comps OB-3 & IB-3), in both species relative to R-OS (Comps IB-1 & IB-2); HPAHs in both species (Comps OB-1 & OB-2 relative to R-OS and Comps OB-3 & IB-2 relative to R-AM), in *Macoma* relative to R-OS (Comp IB-1) and to R-AM (Comps OB-1, IB-1 & IB-3); pesticides in both species (Comp IB-1 relative to R-AM), in *Macoma* relative to both references (OB3 & IB2), and only to R-OS (Comps OB-2, IB-1 & IB-3); PCBs in both species (Comp OB-1 relative to R-OS), in *Macoma* relative to R-OS

(Comp OB-2) and to R-AM (Comps OB-3, IB-1 & IB-2); metals in *Nephtys* relative to R-OS (Comps OB-3, IB-1 & IB-2); and butyltins in both species (Comps OB-2 & IB-3 relative to R-OS and Comp OB-1 relative to RAM), in *Macoma* relative to R-OS (Comps OB-1 & IB-1) and to R-AM (Comps OB-3 & IB-2).

63. Basis for Decisions. Decisions about the suitability of the Project dredged materials for aquatic disposal were jointly made by the staff of EPA Region IX and Corps San Francisco District. The decisions are discussed below and are summarized in Table 2.4-1 of the SEIR/S.

64. OCEAN DISPOSAL DETERMINATIONS

65. Based on the Oakland Inner Harbor channel, turning basin wings and berths sediment test results, the Corps and EPA made the following determinations about suitability for ocean disposal.

- (1) Channel sediments suitable for ocean disposal are characterized by the analysis results for sampling stations and composites Comp I-C1-A, Comp I-C1-B, I-C1-B Special, I-C3, I-C4, I-C5, I-C7, I-C8, I-C9 and I-C14. These sediments were determined to be suitable because: acute toxicity test results did not exceed "Green Book" standards; concentrations of contaminants in tissues were below FDA action limits; and concentrations in tissues were low in relative and absolute terms.
- (2) Channel sediments unsuitable for ocean disposal because of bioaccumulation are characterized by the analysis results for channel sampling stations I-C10, I-C11, I-C12, I-C29 and I-C30. None of the tissue concentrations exceeded FDA action limits. Several HPAHs bioaccumulated to high magnitudes, in I-C10 and Comp III (containing I-C29 and I-C30) in both species. Moderate levels of bioaccumulation were observed in both species for other PAHs, metals and butyltins. Concerns also existed about the reduced survival of *Nephtys* mortality in these sediments and their adjacency to the clearly unsuitable sediments in the turning basin wings.
- (3) Channel sediments unsuitable for ocean disposal because of acute toxicity (amphipod mortality) are characterized by the analysis results for sampling station I-C2 and Composite I-C1-C.
- (4) Channel sediments unsuitable for ocean disposal because of acute toxicity and bioaccumulation are characterized by the analysis results for sampling stations I-C15, I-C16, I-C17 and I-C18. All had significant mortality for the worm (*Nephtys*) in both the 10-day and 28-day solid phase sediment exposures. In I-C17 sediments, the amphipod (*Rhepoxynius*) also showed reduced survival that was not significant because R-OS survival was low. A HPAH bioaccumulated to >10x in I-C15 and I-C18, but bioaccumulation of other PAHs, metals and butyltins was low to moderate. The Inner Harbor channel length authorized for deepening to -42' has been shortened to avoid the sediments characterized by I-C18 and half of those characterized by I-C15, I-C16 and I-C17. They will not be dredged by the -42' Project.
- (5) All Inner Harbor berth sediments (Berth 38, Comp OB-3; Berth 60, Comp IB-1; Berth 61, Comp IB-2; Berths 62 & 63, Comps IB-3) are unsuitable for ocean disposal because of bioaccumulation and, in one instance, because of acute toxicity. None of the tissue

concentrations exceeded FDA action limits. Berth 60 sediments had significant acute toxicity effects on the worm (*Nephtys*) in both 10-day and 28-day solid phase exposures. All these berth sediments were considered unsuitable because of the large number of chemicals bioaccumulating in both test species -- sometimes to high magnitudes.

- (6) Sediments from the wings of the Inner Harbor Turning Basin are unsuitable for ocean disposal because of bioaccumulation and acute toxicity. I-T3 had significant mortality in both the 10-day and 28-day solid phase sediment exposures. Bioaccumulation from the sediments in all 4 samples was characterized by high magnitudes of some contaminants (particularly PAHs) and numerous bioaccumulated contaminants (particularly HPAHs, metals & butyltins) by both species.
- (7) Undisturbed Merritt Sands: EPA and the Corps have determined undisturbed Merritt sand formations are free from anthropogenic contamination and suitable for ocean disposal provided the Merritt sand formations can be adequately separated from overlying contaminated sediments. To do this, the mitigation measures listed in section 4.2.6.2 of the SEIR/S shall be implemented during construction. Table 2.4-2 in the SEIR/S lists the areas that have been identified as having undisturbed Merritt sand formations that will be separated during construction.

66. Based on the Oakland Outer Harbor channel and berths sediment test results, the Corps and EPA made the following determinations about suitability for ocean disposal.

- (1) Channel sediments suitable for ocean disposal are characterized by the analysis results for sampling stations or composites O-C2, O-C3, O-C4-B (except B3 Special), O-C5, O-C6, O-C7, O-C8, O-C9, O-C10, O-C11, O-C12 and O-C13. These sediments were determined to be suitable because: acute toxicity test results did not exceed "Green Book" standards; tissue concentrations were below FDA action limits; absence of toxicity indicated that bioaccumulation was not to harmful levels; bioaccumulated chemicals were from naturally occurring minerals that pose no biologic or human health risks; magnitudes of bioaccumulation were generally low; and the concentrations of bioaccumulated chemicals in Project sediments were low compared to R-OS reference sediments.
- (2) Channel sediments unsuitable for ocean disposal because of bioaccumulation are characterized by the analysis results for sampling stations O-C4A and O-C4-B3 Special. Tissue concentrations did not exceed FDA action levels, but the magnitudes of bioaccumulation were great enough to be of concern. O-C4-A had sufficiently high bioaccumulation of several metals (chromium, mercury, lead and silver) to cause concerns about aquatic disposal. The dark colored, soupy sediments of O-C4-B3-Special were considered to be the source of the PCB and PAHs that bioaccumulated to levels of concern in the tests on Comp OC4-B.
- (3) Channel sediments unsuitable for ocean disposal because of acute toxicity and bioaccumulation are characterized by the analysis results for sampling station O-C1. The solid phase exposure amphipod test showed significant toxicity, and the level of mercury in clam tissues was of concern -- though not exceeding FDA action levels.
- (4) All sediments from Outer Harbor berths (Berth 25, Comp OB-1; Berths 32, 33 & 34, Comp OB-2) and from the shoal (BZ-34) extending out into the channel are unsuitable

for ocean disposal because of bioaccumulation. None of the tissue concentrations exceeded FDA action limits. These sediments were considered unsuitable because of the large number of chemicals bioaccumulating -- sometimes to high magnitudes.

67. IN-BAY DISPOSAL DETERMINATIONS

68. Based on the Oakland Inner Harbor channel, turning basin wings and berths sediment test results, the Corps and EPA made the following determinations about suitability for in-Bay disposal.

- (1) Channel sediments suitable for in-Bay disposal are characterized by the analysis results for sampling stations or composites Comp I-C1-A, Comp I-C1-B, Comp I-C1-B Special, I-C3, I-C4, I-C5 and I-C7. These sediments were determined to be suitable because: acute toxicity test results did not exceed PN 93-2 or "Green Book" standards; tissue concentrations of contaminants were below FDA action limits; and concentrations in tissues were low in relative and absolute terms.
- (2) Channel sediments unsuitable for in-Bay disposal because of acute toxicity and bioaccumulation are characterized by the analysis results for sampling stations I-C10, I-C11, I-C12, I-C14 and I-C15. None of the solid phase amphipod (*Rhepoxynius*) exposure tests showed toxicity in excess of PN 93-2 standards. However, all 10-day and 28-day solid phase worm (*Nephtys*) exposures failed the "Green Book" standard. No tissue concentrations exceeded FDA action levels. For some chemicals, sediment concentrations of concern were accompanied by bioaccumulation to moderate levels, and one PAH bioaccumulated to relatively high levels in two of the samples. Half the sediments characterized by I-C15 will not be dredged by the -42' Project.
- (3) Channel sediments unsuitable for in-Bay disposal because of acute toxicity are characterized by the analysis results for the sampling stations or composites Comp I-C1-C, I-C2, I-C8, I-C9, I-C16 I-C17 and I-C18. Five failures occurred of the PN 93-2 amphipod mortality standard for the solid phase exposure test, and four failures of the "Green Book" standard also occurred (both for the 10-day and 28-day tests). Bioaccumulation did not exceed moderate levels, and few chemicals bioaccumulated. The sediments characterized by I-C18 and half those characterized by I-C16 and I-C17 will not be dredged by the -42' Project.
- (4) Channel sediments unsuitable for in-Bay disposal because of bioaccumulation are characterized by the analysis results for sampling stations I-C29 and I-C30 of Comp III. The sediments contained levels of concern of HPAHs, PCB, tributyltin and metals. A different HPAH bioaccumulated to a high magnitude in each test species exposed to Comp III sediment, and only the I-C29 and I-C30 components of the composite showed high concentrations of those compounds.
- (5) All sediments from the Inner Harbor berths are unsuitable for in-Bay disposal because of bioaccumulation. None of the tissue concentrations exceeded FDA action limits. Berth sediments were considered unsuitable because of the large number of chemicals bioaccumulating in both test species -- PAHs, PCB, the pesticide DDE and tributyltin, sometimes to high magnitudes.

- (6) Sediments from the wings of the Inner Harbor Turning Basin are unsuitable for in-Bay disposal because of bioaccumulation and acute toxicity. In I-T1 and I-SI solid phase exposures the worm (*Nephtys*) mortality rate for both the 10-day and 28-day tests failed the "Green Book" standard. Toxicity in I-T3 and I-T5 sediments did not exceed PN 93-2 or "Green Book" standards. Sediment chemistry showed concentrations of concern of copper, nickel, lead, zinc, PCB, tributyltin and PAHs and some bioaccumulated to magnitudes of concern. None of the tissue concentrations exceeded FDA action limits. Bioaccumulation from the sediments in all 4 samples was characterized by high magnitudes (particularly of PAHs and occasionally of butyltins), usually in both species, and numerous bioaccumulated contaminants -- including metals, PCB & butyltins) by both species. Some of the PAHs bioaccumulating to high magnitudes (e.g., benzo(a)pyrene) are of particular concern for human health reasons.
- (7) Undisturbed Merritt Sands: EPA and the Corps have determined undisturbed Merritt sand formations are free from anthropogenic contamination and suitable for ocean disposal provided the Merritt sand formations can be adequately separated from overlying contaminated sediments. To do this, the mitigation measures listed in section 4.2.6.2 of the SEIR/S shall be implemented during construction. Table 2.4-2 in the SEIR/S lists the areas that have been identified as having undisturbed Merritt sand formations that will be separated during construction.

69. Based on the Oakland Outer Harbor channel and berths sediment test results, the Corps and EPA made the following determinations about suitability for in-Bay disposal.

- (1) Channel sediments suitable for in-Bay disposal are characterized by the analysis results for sampling stations or composites O-C3, O-C4-B (except O-C4-B3 Special), O-C5, O-C6, O-C7, O-C8, O-C10 and O-C11. These sediments were determined to be suitable because: acute toxicity test results did not exceed PN 93-2 or "Green Book" standards; tissue concentrations of contaminants were below FDA action limits; and concentrations in tissues were low in relative and absolute terms.
- (2) Channel sediments unsuitable for in-Bay disposal because of bioaccumulation are characterized by the analysis results for sampling stations O-C4-A and O-C4-B3 Special. None of the tissue concentrations exceeded FDA action limits. The worm, *Nephtys*, bioaccumulated high magnitudes of chromium and lead and lesser magnitudes of other metals. On the basis of sediment chemistry, O-C4-B3 Special sediments were the apparent source of the pesticides and PCB bioaccumulated by both test species exposed to Comp O-C4-B.
- (3) Channel sediments unsuitable for in-Bay disposal because of acute toxicity are characterized by the analysis results for the sampling stations O-C1, O-C2, O-C9, O-C12 and O-C13. Four failed the PN 93-2 amphipod mortality standard for the solid phase exposure test, and one failed the "Green Book" standard (both for the 10-day and 28-day tests) for the worm *Nephtys*. Bioaccumulation did not exceed moderate levels, and few chemicals bioaccumulated.
- (4) All Outer Harbor berth sediments (Berth 25, Comp OB-1; Berths 32, 33 & 34, Comp OB-2) and from a shoal (BZ-34) extending out into the channel are unsuitable for in-Bay disposal because of bioaccumulation. None of the tissue concentrations exceeded FDA action limits. Berth sediments were considered unsuitable because of the number of

chemicals bioaccumulating in both test species -- PAHs, PCB, pesticides, tributyltin and metals, sometimes to high magnitudes.

70. Areas of bottom sediment considered to be represented by each sampling station or composite (polygons) were delineated directly on 1" = 200' scale bathymetric maps of the most recent soundings during Corps-EPA staff meetings on April 2, April 19 and August 30, 1993. Polygon sides were generally drawn at the mid-point between adjacent stations having sediments with differing suitabilities for aquatic disposal -- unless distinct bathymetric features suggested otherwise. Port berthing areas were handled similarly, except that where no distinct bathymetric feature existed the polygon side was drawn to coincide with the mapped boundary between the berth and the Federal channel. If a bathymetric feature, such as a distinct shoal, extended from a berth into the federal channel and there were no nearby channel sampling points, the results of analyses of sediments from berth stations were considered to represent the entire shoal. This occurred at Berth 34.

71. SOURCES OF SEDIMENT QUALITY DATA

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HISTORICAL SUMMARY OF SEDIMENT TESTING IN OAKLAND HARBOR, CALIFORNIA

Oakland Harbor -38-Foot

In spring 1988, 14 stations in Oakland Inner Harbor were collected for testing. Solid-phase testing included a 10-day flow-through test with the polychaete *N. caecoides* and the clam *M. nasuta* and a 10-day static test with the amphipods *R. abronius* and *G. japonica*. Suspended-Particulate-Phase (SPP) testing included a 48-h static test with larvae from the oyster *C. gigas*, a 96-h static test with the mysid *A. sculpta*, and a 4-day static test with the sanddab *C. stigmaeus*. Tissue samples were extracted from *M. nasuta* after a 10-day exposure to the sediment treatments and a 2-day depuration period. Sediment chemistry parameters included conventional parameters (total organic carbon, cyanide, total sulfides, dissolved sulfides, total oil and grease, and total petroleum hydrocarbons), chlorinated pesticides, polychlorinated biphenyls, phenols, phthalates, polynuclear aromatic hydrocarbons, metals (Sb, Ar, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Tl, and Zn), and butyltins (tri-, di, and mono-). Tissue chemistry parameters measured in *M. nasuta* tissues included metals (Hg, Cr, and Pb), butyltins, and polynuclear aromatic hydrocarbons.

Word, J. Q., J. A. Ward, C. W. Apts, D. L. Woodruff, M. E. Barrows, V. I. Cullinan, J. L. Hyland, and J. F. Campbell. 1988. *Confirmatory Sediment Analyses and Solid and Suspended Particulate Phase Bioassays on Sediment from Oakland Inner Harbor, San Francisco, California*. PNL-6794, prepared for the U.S. Army Corps of Engineers, San Francisco District by the Battelle/Marine Sciences Laboratory, Sequim, Washington. Published by the Pacific Northwest Laboratory, Richland, Washington.

Oakland Harbor -42-Foot (Phase I)

In summer 1988, 20 stations were sampled in Oakland Inner Harbor. Solid-phase testing included a 10-day flow-through test with *N. caecoides* and *M. nasuta*; a 10-day static test with *R. abronius* and *A. abdita*; and a 10-day flow-through test with *R. abronius* and *A. abdita*. Tissue samples were extracted from *M. nasuta* after a 10-day exposure to the sediment treatments and a 2-day depuration period. Sediment chemistry parameters included conventional parameters (grain size, total organic carbon, total oil and grease, and total petroleum hydrocarbons), polynuclear aromatic hydrocarbons, chlorinated pesticides, and polychlorinated biphenyls, metals (Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, Se, and Zn) and butyltins. Tissue chemistry parameters measured in *M. nasuta* tissues included polynuclear aromatic hydrocarbons, polychlorinated biphenyls, chlorinated pesticides, metals (Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, Se, and Zn), and butyltins.

Word, J. Q., J. A. Ward, J. A. Strand, V. I. Cullinan, E. A. Crecelius, W. Steinhauer, and J. L. Hyland. 1990. *Ecological Evaluation of Proposed Discharge of Dredged Material from Oakland Harbor into Ocean Waters (Phase I of -42-Foot Project)*. PNL-7484, prepared for the U.S. Army Corps of Engineers, San Francisco District by the Battelle/Marine Sciences Laboratory, Sequim, Washington. Published by the Pacific Northwest Laboratory, Richland, Washington.

Oakland Harbor -42-Foot (Phase II)

In fall 1988, six stations in Oakland Inner Harbor and 15 stations in Oakland Outer Harbor were collected for testing. Solid-phase testing included a 10-day flow-through test with *N. caecoides* and *M. nasuta*; a 10-day static test with *R. abronius* and *A. abdita*; and a 10-day flow-through test with *R. abronius* and *A. abdita*. Tissue samples were extracted from *M. nasuta* after a 10-day exposure to the sediment

treatments and a two-day depuration period. Sediment chemistry parameters included conventional parameters (grain size, total organic carbons, total oil and grease, and total petroleum hydrocarbons), polynuclear aromatic hydrocarbons, chlorinated pesticides, polychlorinated biphenyls, metals (Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, Se, Tl, and Zn), and butyltins. Tissue chemistry parameters measured in *M. nasuta* tissues included polynuclear aromatic hydrocarbons, polychlorinated biphenyls, chlorinated pesticides, metals (Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, Se, and Zn), and butyltins.

Word, J. Q., J. A. Ward, J. A. Strand, N. P. Kohn, and A. L. Squires. 1990. *Ecological Evaluation of Proposed Discharge of Dredged Material from Oakland Harbor into Ocean Waters (Phase II of -42-Foot Project)*. PNL-7483, prepared for the U.S. Army Corps of Engineers, San Francisco District by the Battelle/Marine Sciences Laboratory, Sequim, Washington. Published by the Pacific Northwest Laboratory, Richland, Washington.

Oakland Harbor -42-Foot (Phase III A)

In summer 1990, 35 stations in Oakland Inner and Outer Harbor were sampled for testing. Solid-phase testing included a 10-day and 28-day flow-through test with *N. caecoides* and *M. nasuta*; a 10-day flow-through test with *C. stigmaeus*; and a 10-day static and flow-through test with *R. abronius*. SPP testing included a 96-h static test with the mysid *H. sculpta*; a 96-h static test with the sanddab *C. stigmaeus*; and a 48-h static test with the larvae of the oyster *C. gigas*. Tissue samples were extracted from *M. nasuta* and *N. caecoides* after a 28-day exposure to the sediment treatments and a two-day depuration period. Sediment chemistry parameters included conventional parameters (grain size, total organic carbon, total volatile solids, total oil and grease, and total petroleum hydrocarbons), polynuclear aromatic hydrocarbons, chlorinated pesticides, polychlorinated biphenyls, metals (Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, Se, and Zn), and butyltins. Tissue chemistry parameters measured in *M. nasuta* tissues included polynuclear aromatic hydrocarbons, polychlorinated biphenyls, chlorinated pesticides, metals (Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, Se, and Zn), and butyltins.

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Oakland Harbor -38-Foot

In fall 1990, 31 stations in Oakland Inner Harbor were sampled for testing. Solid-phase testing included a 10-day and 28-day flow-through test with *N. caecoides* and *M. nasuta*; a 10-day flow-through test with *C. stigmaeus*; and a 10-day static and flow-through test with *R. abronius*. SPP testing included a 96-h static test with the mysid *H. sculpta*; a 96-h static test with the sanddab *C. stigmaeus*; and a 48-h static test with larvae of the oyster *C. gigas*. Tissue samples were extracted from *M. nasuta* and *N. caecoides* after a 28-day exposure to the sediment treatments and a two-day depuration period. Sediment chemistry parameters included conventional parameters (grain size, total organic carbon, total volatile solids, total oil and grease, and total petroleum hydrocarbons), polynuclear aromatic hydrocarbons, chlorinated pesticides, polychlorinated biphenyls, metals (Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, Se, and Zn), and butyltins. Tissue chemistry parameters measured in *M. nasuta* tissues included polynuclear aromatic hydrocarbons, polychlorinated biphenyls, chlorinated pesticides, metals (Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, Se, and Zn), and butyltins.

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Oakland Harbor -42-Foot (Phase III B)

In fall 1990, 18 stations in Oakland Inner and Outer Harbor were sampled for testing. Solid-phase testing included a 10-day and 28-day flow-through test with *N. caecoides* and *M. nasuta*; a 10-day flow-through test with *C. stigmaeus*; and a 10-day static and flow-through test with *R. abronius*. SPP testing included a 96-h static test with the mysid *H. sculpta*; a 96-h static test with the sanddab *C. stigmaeus*; and a 48-h static test with larvae of the mussel *M. edulis*. Tissue samples were extracted from *M. nasuta* and *N. caecoides* after a 28-day exposure to the sediment treatments and a two-day depuration period. Sediment chemistry parameters included conventional parameters (grain size, total organic carbon, total volatile solids, total oil and grease, and total petroleum hydrocarbons), polynuclear aromatic hydrocarbons, chlorinated pesticides, polychlorinated biphenyls, metals (Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, Se, and Zn), and butyltins. Tissue chemistry parameters measured in *M. nasuta* tissues included polynuclear aromatic hydrocarbons, polychlorinated biphenyls, chlorinated pesticides, metals (Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, Se, and Zn), and butyltins.

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Oakland Harbor -42-Foot (Follow-Up Study)

In spring 1993, 20 stations in Oakland Inner and Outer Harbors were sampled for testing. Solid-phase testing included a 10-day and 28-day flow-through test with *N. caecoides* and *M. nasuta* and a 10-day static test with *R. abronius*. Suspended-Particulate-Phase testing included a 96-h static test with the mysid, *H. costata*; a 96-h static test with the sanddab, *C. stigmaeus*; and a 48-h static test with larvae of the mussel *M. edulis*. Tissue samples were extracted from *M. nasuta* and *N. Caecoides* after a 28-day exposure to the sediment treatments and a 2-day depuration period. Sediment chemistry parameters included conventional parameters (grain size, total organic carbon, total volatile solids, oil and grease, and total petroleum hydrocarbons), polynuclear aromatic hydrocarbons, chlorinated pesticides, polychlorinated biphenyls, metals (Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, Se, and Zn), and butyltins. Tissue chemistry parameters measured in *M. nasuta* and *N. caecoides* tissues included polynuclear aromatic hydrocarbons, polychlorinated biphenyls, chlorinated pesticides, metals (Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, Se, and Zn), and butyltins.

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Table A-1
Oakland Harbor -42 Foot Project

Conventional Sediment Measurements (Grain Size, TOC and TVS in Percent Dry Weight; Oil and Grease and
TPH in mg/kg Dry Weight)
(page 1 of 4)

<i>Sediment Treatment</i>	<i>Gravel > 2000 um</i>	<i>Sand 62.5- 2000 um</i>	<i>Silt 3.9- 62.5 um</i>	<i>Clay < 3.9 um</i>	<i>TOC</i>	<i>TVS</i>	<i>Oil and Grease</i>	<i>TPH</i>
INNER CHANNEL								
COMP I-C1-A (Intensive)	0	88	5	7	0.03	0.77	12U	12U
I-C1-A1	0	91	4	5	0.05	0.72	23	12U
I-C1-A1	0	91	4	3	0.05	0.84	12U	12U
Special top 5"								
I-C1-A2	0	92	3	5	0.10	0.63	12U	12U
I-C1-A3	0	94	2	4	0.03	0.54	12U	12U
I-C1-A4	0	93	4	3	0.06	0.34	12U	12U
I-C1-A5	0	87	6	7	0.20	0.61	99	58
I-C1-A6	0	93	3	4	0.05	0.53	12U	12U
COMP I-C1-B (Intensive)	0	2	51	47	0.67	3.30	18U	18U
COMP I-C1-B Special	14	23	29	34	0.73	1.51	170	17U
I-C1-B1	1	8	50	41	0.65	2.55	92	36
I-C1-B2	14	11	35	40	0.66	2.07	18U	18U
I-C1-B3	9	30	28	33	0.58	2.07	61	17
I-C1-B4	13	10	28	49	0.70	1.82	18U	18U
I-C1-B5	22	9	35	34	0.67	2.19	20	17U
COMP I-C1-C (Intensive)	0	39	31	30	0.51	2.18	16U	16U
I-C1-C1 top 4"	0	23	42	35	0.63	2.09	52	17U
I-C1-C1	0	3	51	46	0.67	1.90	19	17U
I-C1-C2	0	1	51	48	0.68	1.70	22	17U
I-C1-C3	0	93	3	4	0.06	0.35	12U	12U
I-C1-C4	0	21	35	44	0.94	2.54	180	76
COMP AC-1 (I-C1 TO 18)	1.09	63.80	15.45	19.66	0.18	2.76	19.18	16.19
I-C2 (IIIB)	0	27	35	40	0.87	6.39	138	99
I-C3 (IIIA Repeat)	0	94	2	4	0.04	1.19	9	1
I-C3 (IIIB)	0	92	5	5	0.06	1.23	1	5
I-C4 (IIIA)	0	90.00	2.28	7.73	0.04	1.47	31.59	21.59
I-C4 (IIIB)	0	66	13	21	0.36	3.04	2	12
I-C5 (IIIA)	0	35.77	29.48	34.73	0.64	5.70	102.93*	80.46*
I-C5 (IIIA Repeat)	0	9	40	51	1.08	8.55	121	73
I-C7 (IIIA)	0	91.22	6.53	2.27	0.01	1.20	2.80	2.92
I-C7 (IIIA Repeat)	0	96	1	3	0.03	1.43	7	1
I-C8 (IIIA)	0	93.54	0.94	5.52	0.03	1.89	10.24	8.27
I-C8 TOP 6" (IIIB)	0	52	19	30	0.48	3.93	137	97
I-C9 (IIIA)	0	4.92	38.35	56.73	0.69	7.00	24.82	21.22
I-C9 (IIIA Repeat)	0	20	37	43	0.82	5.48	52	25
I-C10 (IIIA)	0.35	92.69	2.52	4.44	0.04	1.41	5.97	7.46

Table A-1
Oakland Harbor -42 Foot Project

Conventional Sediment Measurements (Grain Size, TOC and TVS in Percent Dry Weight; Oil and Grease and
TPH in mg/kg Dry Weight)
(page 2 of 4)

<i>Sediment Treatment</i>	<i>Gravel > 2000 um</i>	<i>Sand 62.5- 2000 um</i>	<i>Silt 3.9- 62.5 um</i>	<i>Clay < 3.9 um</i>	<i>TOC</i>	<i>TVS</i>	<i>Oil and Grease</i>	<i>TPH</i>
I-C10 (IIIA Repeat)	0	89	4	7	0.11	1.42	39	14
I-C11 (IIIA)	0	91.85	1.79	6.38	0.04	1.58	3.20	1.72
I-C11 (IIIA Repeat)	0	53	28	19	0.06	2.87	34	0.7U
I-C12 (IIIA)	0	96.63	1.54	1.37	0.02	1.25	63.71	20.00
I-C12 (IIIA Repeat)	0	82	6	12	0.17	2.49	49	36
I-C14 (IIIA)	8.66	52.47	23.48	15.40	0.07	2.02	0.60U	2.14
I-C14 (IIIA Repeat)	5	64	18	13	0.10	2.34	7	5
I-C15 (IIIA)	0.25	60.71	24.57	13.93	0.05	2.21	14.76	3.47
I-C15 (IIIA Repeat)	0	38	39	23	0.06	2.99	11	2
I-C16 (IIIA)	0	56.89	21.99	21.13	0.08	2.38	4.19*	1.92*
I-C16 (IIIA Repeat)	0	25	49	26	0.10	3.93	9	7
I-C17 (IIIA)	0	51.30	28.65	20.06	0.09	2.67	9.66	7.58
I-C17 (IIIA Repeat)	0	39	35	26	0.10	3.93	9	7
I-C18 (IIIA)	0.52	40.90	32.50	26.08	0.14	3.51	17.71	20.45
I-C18 (IIIA Repeat)	0	38	38	24	0.06	3.18	28	17
I-C29 (III38) to -39	0	29	31	40	1.01	6.25	245	181
I-C30 (III38) to -39	0	55	19	26	0.60	4.67	14	0.8U
OUTER CHANNEL								
COMP AC-3 (O-C1 to 13)	0	46.94	19.15	33.92	0.53	5.10	33.67	27.50
BC-7 (IIIB)	0	40	23	37	0.55	4.83	150	87
O-C13	0	12	33	55	1.01	7.41	95	84
O-C12	0	64	14	22	0.15	2.51	24	31
O-C11	5	25	27	43	0.65	5.48	65	51
O-C10	0	52	20	28	0.51	4.26	91	66
BC-5 (IIIB)	0	40	24	36	0.66	5.35	116	78
O-C9	0	87	7	6	0.03	0.99	12	3
O-C8	1	11	30	58	1.03	6.68	304	252
O-C7	0	6	35	59	1.11	7.15	251	159
O-C6	0	5	38	57	1.15	7.14	183	135
BC-8 (IIIB)	0	63	17	20	0.34	3.10	63	39
O-C5	0	87	7	6	0.04	1.05	12	4
O-C4-A	0	19	38	43	0.93	5.55	116	70
Comp O-C4-B (Intensive)								
O-C4-B1	0	85	8	7	0.06	0.93	12U	12U
O-C4-B2	0	93	3	4	0.06	0.48	12U	12U
O-C4-B3	0	23	39	38	0.82	3.42	83	59
Special top 1.5'								
O-C4-B3 -38.6-40.1	0	21	39	40	0.95	1.95	92	55

Table A-1
Oakland Harbor -42 Foot Project

Conventional Sediment Measurements (Grain Size, TOC and TVS in Percent Dry Weight; Oil and Grease and
TPH in mg/kg Dry Weight)
(page 3 of 4)

<i>Sediment Treatment</i>	<i>Gravel > 2000 um</i>	<i>Sand 62.5- 2000 um</i>	<i>Silt 3.9- 62.5 um</i>	<i>Clay < 3.9 um</i>	<i>TOC</i>	<i>TVS</i>	<i>Oil and Grease</i>	<i>TPH</i>
O-C4-B3 -40.1-43.7	0	96	2	2	0.04	0.34	12U	12U
O-C4-B4	0	28	31	47	1.04	2.41	660	600
O-C4-B5 -39.6-44.0	0	70	13	17	0.33	1.12	28	32
O-C4-B5 -39.6-42.2	0	23	35	42	0.93	2.74	140	69
O-C4-B5 -42.2-44.0	0	97	1	2	0.02	0.27	12U	12U
BC-6 (IIIB)	0	23	39	38	0.75	5.25	109	61
O-C3	0	28	32	40	0.64	6.46	84	39
O-C1	0	9	49	42	0.81	6.93	80	29
I-C2	0	27	35	40	0.87	6.39	138	99
O-C2 (IIIB)	0	7	45	48	0.75	4.62	58	32
TURNING BASIN WINGS								
I-S1 (IIIA)	0.11*	1.98*	30.16*	67.77*	0.92	7.57	45.89	22.37
I-S1 (IIIA Repeat)	0	4	30	66	1.16	7.26	344	267
I-T1 (IIIA)	0.11	2.24	36.27	61.39	1.22*	10.08*	178.35	159.61
I-T1 (IIIA Repeat)	0	3	34	63	1.33	9.40	190	148
I-T3 (IIIA)	0.05	87.11	5.55	7.29	0.05	1.62	37.61	11.96
I-T3 (IIIA Repeat)	0	86	5	9	0.14	1.90	80	59
I-T5 (IIIA)	0.22*	83.80*	4.58*	11.40*	0.09	1.88	15.01	14.10
I-T5 (IIIB)	0	85	4	11	0.01	1.38	130	106
BERTHS								
COMP OB-1 (Berth 25)	0	89	5	6	0.05	1.19	1.3U	3.8
OB-1(a)	0	80	11	9	0.11	1.02	1.1U	1.1U
OB-1(b)	0	90	4	6	0.05	1.18	11.4	8.0
OB-1(c)	0	89	6	5	0.02	0.95	1.2U	1.2U
COMP OB-2 (Berth 32-34)	0	76	10	14	0.19	2.07	42.9	39.7
OB-2(a)	0	80	8	12	0.18	2.04	40.3	23.4
OB-2(b)	0	89	4	7	0.07	1.28	16.4	11.1
OB-2(e)	0	95	2	3	0.02	0.91	5.7	1.2U
OB-2(f)	0	95	2	3	0.02	0.90	1.2U	1.2U
COMP OB-3 (Berth 38)	0	65	15	20	0.39*	3.28*	80.0	72.4
OB-3(b)	0	76	10	14	0.28	2.43	45.3	42.5
OB-3(c)	0	88	5	7	0.09	1.26	19.7	11.3
COMP IB-1 (Berth 60)	0*	36*	25*	39*	0.79	5.32	363.7	349.1

Table A-1
Oakland Harbor -42 Foot Project

Conventional Sediment Measurements (Grain Size, TOC and TVS in Percent Dry Weight; Oil and Grease and TPH in mg/kg Dry Weight)
(page 4 of 4)

<i>Sediment Treatment</i>	<i>Gravel > 2000 um</i>	<i>Sand 62.5- 2000 um</i>	<i>Silt 3.9- 62.5 um</i>	<i>Clay < 3.9 um</i>	<i>TOC</i>	<i>TVS</i>	<i>Oil and Grease</i>	<i>TPH</i>
IB-1(a)	0	87	5	8	0.09	1.51	27.8	22.1
IB-1(b)	0	51	17	32	0.64	4.54	203.1	169.2
COMP IB-2 (Berth 61)	0	82	6	12	0.18	1.75	109.0	108.3
IB-2(a)	0	95	2	3	0.03	0.78	1.2U	1.2U
IB-2(b)	0	88	5	7	0.10	1.19	52.8	35.7
COMP IB-3 (Berths 62-63)	0	94	1	5	0.07	1.03	6.6	1.3U
IB-3(a)	0	97	1	2	0.03	0.80	1.2U	1.2U
IB-3(b)	0	89	5	6	0.04	0.96	1.2U	1.2U
IB-4(a)	0	96	1	3	0.06*	0.89	1.2U	1.2U
IB-4(b)	0	97	0	3	0.02	0.95	1.2U	1.2U
IB-4(b) top 11"	0	14	31	55	1.14	7.31	261.7	233.5
COMP IB-SPP (all IBs)	0	78	8	14	0.36	2.24	118.3	107.5
REFERENCE SEDIMENTS								
R-AM (IIIA)	2.73*	92.41*	1.06*	3.80*	0.03	1.32	3.59	2.63
R-AM (IIIA Repeat)	4	94	1	1	0.07	2.13	13	0.6U
R-AM (IIIB)	0	91	3	6	0.19	2.10	0.7U	8
R-AM (Berths)	7	90	1	2	0.11	2.30	1.3U	1.3U
R-AM (Intensive)	3	94	1	2	0.78	0.24	41	12U
R-OS (IIIA)	6.77	48.24	25.67	19.31	0.57	4.93	3.91	10.10
R-OS (IIIA Repeat)	0	32	46	22	1.00	6.99	72	0.9U
R-OS (IIIB)	0	60	27	13	0.63*	4.28*	14*	6.7*
R-OS (Berths)	0	59	25	16	0.74*	4.38*	11.5	1.3U
R-OS (Intensive)	0	45	35	20	0.79	2.34	16U	16U

Notes: * mean of replicate sample analyses
 U concentration is less than given detection limit
 (IIIA), (IIIB), (IIIC), (Berths), or (Intensive) refers to the Battelle testing phase for the sediment analysis report.

Table A-2
Oakland Harbor -42 Foot Project
Sediment Metals (mg/kg Dry Weight)
(page 1 of 5)

<i>Sediment Treatment</i>	METALS									
	<i>Ag</i>	<i>As</i>	<i>Cd</i>	<i>Cr</i>	<i>Cu</i>	<i>Hg</i>	<i>Ni</i>	<i>Pb</i>	<i>Se</i>	<i>Zn</i>
INNER CHANNEL										
COMP I-C1-A (Intensive)	0.039	3.91	0.1U	231	10.4	0.026	35.0	7.4	0.12U	29.1
I-C1-A1	0.033	3.77	0.1U	339	10.2	0.018	62.2	6.4	0.13	36.2
I-C1-A1 Special top 5"	0.039	3.56	0.1U	212	32.3	0.033	46.9	6.3	0.12U	33.8
I-C1-A2	0.049	4.25	0.1U	482	14.2	0.025	39.1	6.0	0.12U	36.2
I-C1-A3	0.030	3.11	0.1U	310	8.8	0.018	31.8	7.7	0.14	26.2
I-C1-A4	0.026	2.13	0.1U	249	11.6	0.018	32.9	8.8	0.12U	24.5
I-C1-A5	0.118	5.07	0.119	525	14.9	0.096	44.3	10.1	0.12U	43.7
I-C1-A6	0.034	3.78	0.1U	420	10.4	0.024	31.1	6.6	0.12U	27.9
COMP I-C1-B (Intensive)	0.117	11.1	0.161	190	50.9	0.081	114	11.1	0.34	107
COMP I-C1-B Special	0.197	10.6	0.272	191	37.7	0.398	86.8	13.8	0.34	92.2
I-C1-B1	0.246	10.7	0.319	187	48.0	0.200	105	19.1	0.20	107
I-C1-B2	0.090	10.0	0.210	161	44.6	0.073	104	8.4	0.34	92.0
I-C1-B3	0.082	10.0	0.182	216	38.1	0.091	83.2	11.0	0.20	81.6
I-C1-B4	0.104	10.4	0.238	157	47.4	0.074	110	10.2	0.35	99.4
I-C1-B5	0.099	10.2	0.240	167	49.0	0.067	108	8.7	0.21	95.9
COMP I-C1-C (Intensive)	0.127	10.2	0.153	299	31.7	0.090	81.6	10.9	0.21	83.1
I-C1-C1 top 4"	0.142	11.0	0.171	224	39.9	0.099	95.4	11.0	0.20	93.9
I-C1-C1	0.128	11.8	0.202	186	47.6	0.072	105	10.3	0.34	102
I-C1-C2	0.099	12.6	0.213	190	46.9	0.076	117	11.4	0.21	103
I-C1-C3	0.037	3.89	0.1U	331	9.9	0.018	29.3	5.6	0.12U	25.3
I-C1-C4	0.366	13.2	0.266	233	51.5	0.294	100	30.7	0.21	131
COMP AC-1 (I-C1 TO 18)	0.128	4.74	0.160	444	25.1	0.104	67.9	14.0	0.22U	61.6
I-C2 (IIB)	0.414	7.7	0.40	276	55.7	0.310@	96.3	33.7	0.24	126.0
I-C3 (IIIA Repeat)	0.10	3.00	0.05	410	11.1	0.046	34.1	8.1	0.07U	27.6
I-C3 (IIB)	0.031	4.06	0.11	476	12.1	0.035#	35.7	8.0	0.11U	31.6
I-C4 (IIIA)	0.051	4.25	0.069	488	12.1	0.028	58.1	4.9	0.22U	42.2
I-C4 (IIB)	0.145	5.43	0.19	455	27.6	0.124#	73.6	15.4	0.11U	78.2
I-C5 (IIIA)	0.327	10.10	0.230	299	42.1	0.240	95.0	23.1	0.22U	117.1

Table A-2
Oakland Harbor -42 Foot Project
Sediment Metals (mg/kg Dry Weight)
(page 2 of 5)

<i>Sediment Treatment</i>	METALS									
	<i>Ag</i>	<i>As</i>	<i>Cd</i>	<i>Cr</i>	<i>Cu</i>	<i>Hg</i>	<i>Ni</i>	<i>Pb</i>	<i>Se</i>	<i>Zn</i>
I-C5 (IIIA Repeat)	0.38	12.60	0.25	218	84.9	0.359	111.1	39.1	0.30	146.4
I-C7 (IIIA)	0.038	1.73	0.059	374	9.3	0.014	52.7	8.2	0.22U	37.8
I-C7 (IIIA Repeat)	0.07*	3.23*	0.03*	371*	11.4*	0.007*	49.3*	5.4*	0.07U*	34.4*
I-C8 (IIIA)	0.050	5.24	0.088	433	13.3	0.030	60.0	5.8	0.22U	41.9
I-C8 (IIIA Repeat)	0.08	3.60	0.06	322	15.6	0.026	47.1	6.3	0.07U	41.5
I-C8 (IIIB)	0.064	4.68	0.15	458	19.8	0.167	56.2	10.8	0.11U	56.2
I-C8 TOP 6" (IIIB)	0.278	4.74	0.31	343	42.1	\$	84.7	28.2	0.11U	100.2
I-C9 (IIIA)	0.185	12.10	0.300	240	53.2	0.128	125.5	14.4	0.22	120.6
I-C9 (IIIA Repeat)	0.49	8.80	0.44	357	59.5	0.331	115.5	31.9	0.26	133.6
I-C10 (IIIA)	0.051	2.20	0.130	977	12.2	0.037	65.7	7.5	0.22U	56.7
I-C10 (IIIA Repeat)	0.15	3.60	0.10	722	17.2	0.084	67.1	8.1	0.07U	56.3
I-C11 (IIIA)	0.056	1.40U	0.094	665	14.4	0.049	57.1	9.6	0.22U	52.0
I-C11 (IIIA Repeat)	0.10	3.02	0.08	371	19.7	0.044	64.4	9.7	0.07U	50.1
I-C12 (IIIA)	0.044	2.40	0.046	536	10.1	0.016	50.9	7.1	0.22U	43.1
I-C12 (IIIA Repeat)	0.13	4.50	0.10	603	21.4	0.092	65.8	12.2	0.07U	66.7
I-C14 (IIIA)	0.076	3.65	0.095	168	16.6	0.047	45.3	7.5	0.22U	35.0
I-C14 (IIIA Repeat)	0.06	4.39	0.18	299	17.8	0.077	46.8	10.2	0.08U	38.2
I-C15 (IIIA)	0.082	4.76	0.078	291	16.4	0.056	57.3	7.6	0.22U	46.6
I-C15 (IIIA Repeat)	0.05	4.17	0.10	207	20.9	0.040	56.4	8.1	0.08	42.7
I-C16 (IIIA)	0.072	6.17	0.120	252	17.0	0.078	64.6	8.3	0.22U	45.6
I-C16 (IIIA Repeat)	0.06	3.22	0.14	209	27.1	0.044	74.5	12.7	0.08U	56.6
I-C17 (IIIA)	0.090	3.58	0.130	262	19.8	0.071	62.7	10.0	0.22U	49.8
I-C17 (IIIA Repeat)	0.07	3.61	0.11	186	24.3	0.058	67.1	11.6	0.07U	51.6
I-C18 (IIIA)	0.159	5.39	0.180	191	24.8	0.148	63.3	15.2	0.22U	66.4
I-C18 (IIIA Repeat)	0.06	2.97	0.08	140	22.2	0.052	63.0	12.2	0.07U	45.1
I-C29 (III38) to -39	0.87	11.40	0.99	282	82.9	1.280	103.0	63.5	0.18	216.0
I-C30 (III38) to -39	0.28	7.94	0.25	285	46.3	0.264	80.4	25.7	0.08U	107.1
OUTER CHANNEL										
COMP AC-3 (O-C1 to 13)	0.350	7.90	0.300	415	39.2	0.226	91.1	26.3	0.22U	106.4
BC-7 (IIIB)	0.280	7.20	0.38	306	46.5	0.211#	107.3	25.5	0.12	165.0

Table A-2
Oakland Harbor -42 Foot Project
Sediment Metals (mg/kg Dry Weight)
(page 3 of 5)

<i>Sediment Treatment</i>	METALS									
	<i>Ag</i>	<i>As</i>	<i>Cd</i>	<i>Cr</i>	<i>Cu</i>	<i>Hg</i>	<i>Ni</i>	<i>Pb</i>	<i>Se</i>	<i>Zn</i>
O-C13	0.503	11.6	0.60	230	69.1	0.417#	114.8	48.0	0.25	165.0
O-C12	0.084	1.89	0.25	427	23.8	0.051@	88.7	14.1	0.12	73.7
O-C11	0.291	9.70	0.38	330	51.3	0.155#	112.2	29.0	0.19	124.6
O-C10	0.285*	7.00*	0.36*	320*	39.9*	0.199@	88.7*	25.2*	0.12*	102.2*
BC-5 (IIIB)	0.395	5.86	0.31	411	43.7	\$	94.2	32.8	0.11U	115.1
O-C9	0.029	1.65	0.08	478	12.8	0.070@	60.1	8.9	0.11U	43.5
O-C8	0.518	12.4	0.57	233	70.1	0.460#	115.2	47.1	0.24	175.0
O-C7	0.480	11.8	0.42	208	65.4	0.466#	114.7	49.8	0.30	170.2
O-C6	0.433	10.8	0.37	221	64.9	0.490@	115.7	47.5	0.24	167.1
BC-8 (IIIB)	0.158*	5.24*	0.19*	387*	27.2*	\$	72.2*	15.5*	0.11U*	71.5*
O-C5	0.032	2.78	0.10	531	12.9	0.065@	57.1	7.5	0.11U	39.1
O-C4-A	0.313	10.3	0.30	252	51.8	0.117@	99.5	30.3	0.18	145.1
COMP O-C4-B (Intensive)	0.129	4.43	0.110	433	21.0	0.091	76.1	12.5	0.13	63.5
O-C4-B1	0.052	2.65	0.1U	410	11.5	0.029	70.6	3.8	0.12U	41.8
O-C4-B2	0.027*	3.25*	0.1U*	297*	10.3*	0.020*	53.6*	5.2*	0.12U*	33.3*
O-C4-B3 Special top 1.5'	0.306	11.6	0.137	287	45.3	0.296	98.8	26.1	0.27	119
O-C4-B3 -38.6-40.1	0.325	10.4	0.169	213	46.6	0.303	92.9	28.4	0.21	120
O-C4-B3 -40.1-43.7	0.023	1.43	0.1U	427	9.0	0.031	58.7	7.0	0.12U	35.6
O-C4-B4	0.603	10.9	0.554	257	54.7	0.480	96.3	44.7	0.27	140
O-C4-B5 -39.6-44.0	0.150	8.35	0.121	473	25.3	0.128	76.3	13.6	0.12U	77.7
O-C4-B5 -39.6-42.2	0.364	12.5	0.190	224	48.4	0.330	92.3	29.2	0.27	128
O-C4-B5 -42.2-44.0	0.023	3.21	0.1U	627	11.5	0.016U	57.2	6.3	0.12U	42.3
BC-6 (IIIB)	0.255	9.64	0.31	276	49.5	\$	101.7	22.5	0.19	112.9
O-C3	0.177	10.9	0.33	204	43.4	0.204#	92.1	15.0	0.11U	96.6
O-C1	0.166	10.15	0.29	175	43.4	0.149#	98.2	17.1	0.24	102.5
I-C2	0.414	7.7	0.40	276	55.7	0.310@	96.3	33.7	0.24	126.0
O-C2 (IIIB)	0.062	9.13	0.31	221	48.6	0.070@	114.7	17.8	0.18	109.2

Table A-2
Oakland Harbor -42 Foot Project
Sediment Metals (mg/kg Dry Weight)
(page 4 of 5)

<i>Sediment Treatment</i>	METALS									
	<i>Ag</i>	<i>As</i>	<i>Cd</i>	<i>Cr</i>	<i>Cu</i>	<i>Hg</i>	<i>Ni</i>	<i>Pb</i>	<i>Se</i>	<i>Zn</i>
TURNING BASIN WINGS										
I-S1 (IIIA)	0.271	9.90	0.460	208	63.1	0.257	132.8	29.6	0.22U	151.3
I-S1 (IIIA Repeat)	0.59	10.40	0.76	204	86.1	0.812	126.1	65.3	0.38	222.0
I-T1 (IIIA)	0.629*	12.93*	0.385*	209*	80.7*	0.524*	122.1*	52.3*	0.22U	188.4*
I-T1 (IIIA Repeat)	0.50*	12.50*	0.35*	233*	83.6*	0.476*	120.8*	52.5*	0.36*	183.6*
I-T3 (IIIA)	0.067	4.35	0.093	687	15.3	0.067	68.9	9.0	0.22U	53.5
I-T3 (IIIA Repeat)	0.10	3.96	0.12	564	26.3	0.173	62.9	17.3	0.07U	65.9
I-T5 (IIIA)	0.093	4.94	0.099	455	20.9	0.086	69.3	10.9	0.22U	56.5
I-T5 (IIIB)	0.026	3.12	0.09	314	14.5	0.031#	68.7	5.3	0.11U	43.5
BERTHS										
COMP OB-1 (Berth 25)	0.031	3.00	0.06	351	9.7	0.011	58.5	9.0	0.13	37.6
OB-1(a)	0.023	3.11	0.08	586	12.11	0.009	65.8	5.7	0.13	44.4
OB-1(b)	0.044	3.95	0.07	471	13.8	0.036	63.3	6.6	0.12U	42.0
OB-1(c)	0.019	3.19	0.06	384	10.7	0.007	57.6	6.7	0.20	36.0
COMP OB-2 (Berths 32-34)	0.116	5.10	0.10	333	17.6	0.066	69.2	12.4	0.12U	53.1
OB-2(a)	0.106	2.93	0.07	338	17.8	0.067	66.1	10.9	0.12U	53.6
OB-2(b)	0.056	2.29	0.07	414	13.9	0.022	60.2	8.9	0.13	43.1
OB-2(c)	0.170	4.64	0.11	282	26.7	0.101	69.3	16.7	0.12U	69.5
OB-2(d)	0.120	3.62	0.09	226	23.9	0.070	68.7	13.2	0.12U	54.3
OB-2(e)	0.019	2.61	0.04	396	10.3	0.005	57.0	7.1	0.13	35.7
OB-2(f)	0.027	2.15	0.04	448	11.3	0.007	56.8	6.9	0.12U	36.0
COMP OB-3 (Berth 38)	0.201*	6.86*	0.19*	355*	27.7*	0.132*	74.9*	17.7*	0.13*	73.2*
OB-3(b)	0.145	4.62	0.13	427	28.6	0.089	67.4	13.0	0.20	59.7
OB-3(c)	0.078	3.75	0.10	369	17.2	0.034	48.3	8.1	0.12U	37.1
COMP IB-1 (Berth 60)	0.519	8.20	0.39	264	53.1	0.330	93.8	36.4	0.26	133.4
IB-1(a)	0.057	3.06	0.10	527	15.1	0.044	59.9	9.9	0.20	48.8
IB-1(b)	0.352	6.72	0.29	291	43.7	0.214	82.9	26.5	0.33	103.2
COMP IB-2 (Berth 61)	0.078	3.23	0.13	450	15.7	0.172	55.4	11.8	0.20	49.9
IB-2(a)	0.015	2.87	0.07	414	10.5	0.003	49.1	5.4	0.12U	37.3

Table A-2
Oakland Harbor -42 Foot Project
Sediment Metals (mg/kg Dry Weight)
(page 5 of 5)

<i>Sediment Treatment</i>	METALS									
	<i>Ag</i>	<i>As</i>	<i>Cd</i>	<i>Cr</i>	<i>Cu</i>	<i>Hg</i>	<i>Ni</i>	<i>Pb</i>	<i>Se</i>	<i>Zn</i>
IB-2(b)	0.074	4.21	0.13	461	15.3	0.040	54.7	9.9	0.20	47.6
COMP IB-3 (Berths 62-63)	0.035	4.03	0.09	455	11.6	0.017	53.6	8.7	0.13	43.2
IB-3(a)	0.010U	3.13	0.03	141	9.1	0.011	43.6	7.3	0.27	26.4
IB-3(b)	0.036	2.93	0.18	823	13.8	0.007	54.9	7.2	0.12U	46.2
IB-4(a)	0.015	2.73	0.07	243	11.1	0.013	49.4	7.7	0.13	35.0
IB-4(b)	0.019	2.96	0.09	467	11.5	0.003	52.8	7.0	0.13	38.4
IB-4(b) top 11"	0.508	10.50	0.33	220	66.1	0.379	117.0	41.9	0.40	165.9
COMP IB-SPP (all IBs)	0.195	6.44	0.17	420	29.6	0.121	73.8	16.1	0.13	72.3
REFERENCE SEDIMENTS										
R-AM (IIIA)	0.048	5.83	0.046	113	7.9	0.036	33.5	14.2	0.22U	32.0
R-AM (IIIA Repeat)	0.02	13.20	0.04	121	11.4	0.048	38.8	11.0	0.08U	35.4
R-AM (IIIB)	0.033	6.55	0.09	156	12.4	0.057#	40.7	14.4	0.11U	37.7
R-AM (Berths)	0.015	8.01	0.05	136	11.7	0.009	51.8	13.8	0.12U	32.3
R-AM (Intensive)	0.042	9.1	0.1U	190	11.5	0.036	42.3	15.2	0.12U	36.8
R-OS (IIIA)	0.390	3.88	0.570	192	23.9	0.063	66.7	9.6	0.74	91.4
R-OS (IIIA Repeat)	0.28	4.25	0.38	240	27.0	0.112	75.1	6.9	1.11	88.7
R-OS (IIIB)	0.190*	3.92*	0.31*	255*	20.3*	0.217*	63.5*	9.1*	0.56*	82.5*
R-OS (Berths)	0.347*	4.25*	0.33*	247*	21.8*	0.058*	70.0*	6.8*	1.21*	82.3*
R-OS (Intensive)	0.259	5.33	0.411	197	21.8	0.081	69.4	8.2	0.83	76.3

Notes: * mean of replicate sample analyses
 U concentration is less than given detection limit
 # concentration from analysis of archived 42 Phase IIIB sample
 @ value is from 42 Phase II Report because no archived sample existed from 42 Phase IIIB.
 \$ 42 Phase IIIB Report value for mercury is too high by some unknown, large amount & no archived sample existed for reanalysis & no equivalent equivalent sample was collected by earlier phases.
 (IIIA), (IIB), (IIIB), (Berths), or (Intensive) refers to the Battelle testing phase for the sediment analysis report.

Table A-3
Oakland Harbor -42 Foot Project
Butyltins, Total Polynuclear Aromatic Hydrocarbons (PAHs), PCBs, and Pesticides
(µg/kg Dry Weight)
(page 1 of 6)

Sediment Treatment	PAHS ABOVE DETECTION LIMIT			BUTYLTIN SPECIES			PCB	CHLORINATED PESTICIDES	
	Molecular Weight		Total PAH	Tributyl	Dibutyl	Monobutyl		Total DDD, DDE, & DDT	Others
	Total Low	Total High							
INNER CHANNEL									
COMP I-C1-A (Intensive)	8	7	15	0.7U	1.2U	1.3U	2.8U	Ux	Ux
I-C1-A1	6	36	42	0.7U	1.2U	1.3U	2.8U	Ux	Ux
I-C1-A1 Special top 5"	9	35	44	4.8	1.2U	1.3U	2.8U	0.78	Ux
I-C1-A2	7	14	21	0.7U	1.2U	1.3U	2.8U	Ux	Ux
I-C1-A3	7	14	21	0.7U	1.2U	1.3U	2.8U	Ux	Ux
I-C1-A4	12	33	52	1.4	1.2U	1.3U	2.8U	Ux	Ux
I-C1-A5	62	348	410	0.7U	1.2U	1.3U	41	2.6	Ux
I-C1-A6	6	13	19	0.7U	1.2U	1.3U	2.8U	Ux	Ux
COMP I-C1-B (Intensive)	31	84	115	0.7U	1.2U	1.3U	2.8U	0.78	Ux
COMP I-C1-B Special	286	1,430	1,716	3.9	1.2U	1.3U	18	2.8	Ux
I-C1-B1	94	628	722	0.7U	1.2U	1.3U	16	3.2	Ux
I-C1-B2	138	133	271	1.8	1.2U	1.3U	2.8U	Ux	Ux
I-C1-B3	836	3,120	3,956	0.7U	1.2U	1.3U	2.8U	Ux	Ux
I-C1-B4	111	60	171	0.7U	1.2U	1.3U	2.8U	Ux	Ux
I-C1-B5	57	46	103	0.7U	1.2U	1.3U	18	Ux	Ux
COMP I-C1-C (Intensive)	76	477	553	1.2	1.2U	1.3U	2.8U	1.8	Ux
I-C1-C1 top 4"	7,260	16,000	23,260	1.1	1.2U	1.3U	2.8U	1.9	Ux
I-C1-C1	197	348	545	0.7U	1.2U	1.3U	2.8U	Ux	Ux
I-C1-C2	55	42	97	0.7U	1.2U	1.3U	28	Ux	Ux
I-C1-C3	44	31	75	0.7U	1.2U	1.3U	17	Ux	Ux
I-C1-C4	312	1,480	1,792	3.9	2.0	1.3U	16	6.8	Ux
COMP AC-1 (I-C1 TO 18)	38	223	261	3.60+	3.40	1.20	16	6U	Ux
I-C2 (IIIB)	269	1,781	2,050	5.5	2.6	1.8	50	5.0U	Ux
I-C3 (IIIA Repeat)	Ux	Ux	Ux	0.9U	0.7U	0.7U	24U	2.0U	Ux
I-C3 (IIIB)	7	84	91	1.0U	1.0U	1.6	20U	5.0U	Ux
I-C4 (IIIA)	4	29	33	1.20+	1.10	0.64U	40U	6U	Ux
I-C4 (IIIB)	136	831	967	4.0	3.3	1.9	20U	5.0U	Ux

Table A-3
Oakland Harbor -42 Foot Project
Butyltins, Total Polynuclear Aromatic Hydrocarbons (PAHs), PCBs, and Pesticides
($\mu\text{g/kg}$ Dry Weight)
(page 2 of 6)

Sediment Treatment	PAHS ABOVE DETECTION LIMIT			BUTYLTIN SPECIES			PCB	CHLORINATED PESTICIDES	
	<u>Molecular Weight</u>			Tributyl	Dibutyl	Monobutyl		Total DDD, DDE, & DDT	Others
	Total Low	Total High	Total PAH						
I-C5 (IIIA)	114	856	970	5.10+	4.60	2.20	19	10U	Ux
I-C5 (IIIA Repeat)	132	1,300	1,432	8.8+*	0.5U*	2.1*	72*	10.6	5.3 Dieldrin
I-C7 (IIIA)	1.5*	16*	17.5	0.92+	0.64	0.66U	40U*	6U*	Ux
I-C7 (IIIA Repeat)	Ux	Ux	Ux	0.9+*	0.5U*	0.5U*	25U*	Ux*	Ux
I-C8 (IIIA)	1	16	17	0.93+	0.61U	0.58U	40U	6U	Ux
I-C8 (IIIA Repeat)	Ux	Ux	Ux	3.5+	2.4U	2.3U	26U	3.0U	Ux
I-C8 (IIIB)	65	619	684	5.9*	2.9*	1.8*	20U	5.0U	Ux
I-C8 TOP 6" (IIIB)	344*	2,824*	3,168	ND	ND	ND	28*	5.0U*	Ux
I-C9 (IIIA)	15	164	179	6.30+	3.50	0.93	60U	10U	Ux
I-C9 (IIIA Repeat)	Ux	Ux	Ux	40.4+	15.0	4.4	33U	3.0U	Ux
I-C10 (IIIA)	29	315	344	2.35+*	1.95*	0.60*	40U	6U	Ux
I-C10 (IIIA Repeat)	58	963	1,021	7.0+	4.0	0.8	25U	3.0	Ux
I-C11 (IIIA)	11	161	172	1.70+	1.80	0.67	40U	6U	Ux
I-C11 (IIIA Repeat)	Ux	Ux	Ux	3.3U	2.8U	2.7U	Ux*	3.0U*	Ux
I-C12 (IIIA)	2	16	18	1.10+	0.98	0.53U	40U	6U	Ux
I-C12 (IIIA Repeat)	75*	1,645*	1,720	8.0+	4.9	0.9	Ux*	3.0U*	Ux
I-C14 (IIIA)	1	Ux	1	0.81+	1.30	0.47U	40U	6U	Ux
I-C14 (IIIA Repeat)	Ux	117	117	2.8+	1.4	0.4U	26U	3.0U	Ux
I-C15 (IIIA)	6	150	156	1.10+	0.92	0.57	40U	6U	Ux
I-C15 (IIIA Repeat)	Ux	Ux	Ux	0.8+	0.6U	0.5U	29U	3.0U	Ux
I-C16 (IIIA)	1	2	3	0.87+	1.20	0.64	40U	6U	Ux
I-C16 (IIIA Repeat)	Ux	Ux	Ux	0.6+	0.4U	0.4U	31U	3.0U	Ux
I-C17 (IIIA)	3	32	34	1.40+	1.30	0.56	40U	6U	Ux
I-C17 (IIIA Repeat)	Ux	82	82	1.1+	0.6	0.3U	24U	2.0U	Ux
I-C18 (IIIA)	17	276	293	4.00+	4.10	0.67	40U	6U	Ux
I-C18 (IIIA Repeat)	Ux	Ux	Ux	0.9+	0.4U	0.4U	25U	11.0	Ux
I-C29 (III38)	223	3,508	3,731	35	19	6	387	6.5	5.2 BBHC
I-C30 (III38)	221	2,415	2,637	33	17	3	33.9U	12.2	4.6 Dieldrin

Table A-3
Oakland Harbor -42 Foot Project
Butyltins, Total Polynuclear Aromatic Hydrocarbons (PAHs), PCBs, and Pesticides
($\mu\text{g/kg}$ Dry Weight)
(page 3 of 6)

Sediment Treatment	PAHS ABOVE DETECTION LIMIT			BUTYLTIN SPECIES			PCB	CHLORINATED PESTICIDES	
	<i>Molecular Weight</i>			Tributyl	Dibutyl	Monobutyl		Total DDD, DDE, & DDT	Others
	Total Low	Total High	Total PAH						
OUTER CHANNEL									
COMP AC-3 (O-C1 to 13)	20	124	144	3.70+	8.80	0.65U	70	6U	Ux
BC-7 (IIIB)	219	1,065	1,284	6.1	1.3	1.4	36	5.0U	Ux
O-C13	431	2,407	2,838	9.1	7.1	2.8	65	6.0	Ux
O-C12	19	178	197	1.3	1.2	1.0U	20U	5.0U	Ux
O-C11	214	1,469	1,683	5.4	4.5	3.1	34	5.0U	Ux
O-C10	151*	1,054*	1,205	8.3*	4.5*	1.3*	32*	5.0U*	Ux
BC-5 (IIIB)	201	1,406	1,607	3.3	1.7	1.1	51	5.0U	Ux
O-C9	Ux	Ux	Ux	1.0U	1.0U	1.0	20U	5.0U	Ux
O-C8	276	1,713	1,989	8.3	6.5	3.7	89	5.0U	8.1 Endrin
O-C7	270	2,016	2,286	5.9	9.9	2.4	63	5.0U	Ux
O-C6	270	2,017	2,287	5.7	8.4	4.8	41	5.0U	Ux
BC-8 (IIIB)	160*	914*	1,074	1.8	1.1	1.0U*	27	5.0U*	Ux*
O-C5	6	77	83	1.0U	1.0	1.0U	20U	5.0U	Ux
O-C4-A	495	2,552	3,047	5.6	2.3	16	20U	5.0U	Ux
COMP O-C4-B (Intensive)	73	413	486	1.5	1.2U	1.3U	17	2.8	Ux
O-C4-B1	40	32	72	0.7U	1.2U	1.3U	2.8U	Ux	Ux
O-C4-B2	37	45	82	0.7U	1.2U	1.3U	2.8U	0.4*	Ux*
O-C4-B3 Special top 1.5'	237	1,600	1,837	4.0	2.1	1.3U	28	6.3	Ux
O-C4-B3 -38.6-40.1	274	1,530	1,804	4.0	2.2	1.3U	35.1	7.8	Ux
O-C4-B3 -40.1-43.7	70	39	109	0.7U	1.2U	1.3U	2.8U	Ux	Ux
O-C4-B4	404	1,610	2,014	0.8	1.2U	1.3U	433	22.1	3.3 Dield., 2.4 Hept.
O-C4-B5 -39.6-44.0	242	1,020	1,262	4.9	1.4	1.3U	12.4	3.7	Ux
O-C4-B5 -39.6-42.2	237	1,310	1,547	5.5	2.5	1.3U	34.5	13.8	1.0 Aldr., 1.0 Dield.
O-C4-B5 -42.2-44.0	43	16	59	0.7U	1.2U	1.3U	2.8U	Ux	Ux

Table A-3
Oakland Harbor -42 Foot Project
Butyltins, Total Polynuclear Aromatic Hydrocarbons (PAHs), PCBs, and Pesticides
(μg/kg Dry Weight)
(page 4 of 6)

<i>Sediment Treatment</i>	PAHS ABOVE DETECTION LIMIT			BUTYLTIN SPECIES			<i>PCB</i>	CHLORINATED PESTICIDES	
	<i>Molecular Weight</i>								
	<i>Total Low</i>	<i>Total High</i>	<i>Total PAH</i>	<i>Tributyl</i>	<i>Dibutyl</i>	<i>Monobutyl</i>		<i>Total DDD, DDE, & DDT</i>	<i>Others</i>
BC-6 (IIIB)	269	1,690	1,959	3.3	1.5	1.0U	23	5.0U	Ux
O-C3	170	1,236	1,406	2.1	1.0U	1.0U	20U	5.0U	Ux
O-C1	188	1,061	1,249	6.7	1.3	1.0U	20U	5.0U	Ux
I-C2	269	1,781	2,050	5.5	2.6	1.8	50	5.0U	Ux
O-C2 (IIIB)	82	381	463	1.0U	1.0U	1.0U	20U	5.0U	Ux
TURNING BASIN WINGS									
I-S1 (IIIA)	288	1,032	1,320	3.20+	1.50	0.97	28	10U	Ux
I-S1 (IIIA Repeat)	606	5,773	6,379	17.5+	12.9	2.5	97	4.0U	Ux
I-T1 (IIIA)	194	2,421	2,615	34.20	30.00	5.80	66	12U	Ux
I-T1 (IIIA Repeat)	260	3,293	3,499	29.2+	18.6	5.8	140	4.0U	Ux
I-T3 (IIIA)	22	380	402	12.00+	8.70	1.50	26	6U	Ux
I-T3 (IIIA Repeat)	105	1,212	1,317	64.3+	27.4	3.5	400	3.0U	Ux
I-T5 (IIIA)	32	528	560	48.00	18.00	4.30	40U	6U	Ux
I-T5 (IIIB)	Ux	Ux	Ux	1.0U	1.0U	1.0U	20U	5.0U	Ux
BERTHS									
COMP OB-1 (Berth 25)	98	384	482	2.1	0.5U	1.6+	20U	Ux	Ux
OB-1(a)	1	Ux	1	0.6	0.4U	0.4U	20U	Ux	0.3 aBHC
OB-1(b)	742	245	987	1.8	0.5U*	0.5	20U	Ux	0.5 aBHC
OB-1(c)	1*	2*	3	0.7*	0.5U*	0.4U*	20U*	Ux	.2*-.4* 3 BHCs
COMP OB-2(Berths 32-34)	49	409	458	3.8	0.6U	0.5U	20U	1.5	0.4 Lindane
OB-2(a)	48	366	414	3.3	0.8	0.8+	20U	2.5	0.7 aBHC
OB-2(b)	25	239	264	1.5	1.0	0.5U	20U	0.9	0.4 aBHC
OB-2(c)	61	573	634	3.8	1.5	1.1+	50	3.2	.1-.5 4 Pesticides
OB-2(d)	45	412	457	4.3	1.3	0.9+	20U	1.6	Ux
OB-2(e)	1	Ux	1	0.8	0.6U	0.6	20U	Ux	0.4 aBHC
OB-2(f)	1	Ux	1	0.7	0.6U	0.5U	20U	Ux	0.3 aBHC

Table A-3
Oakland Harbor -42 Foot Project
Butyltins, Total Polynuclear Aromatic Hydrocarbons (PAHs), PCBs, and Pesticides
(µg/kg Dry Weight)
(page 5 of 6)

Sediment Treatment	PAHS ABOVE DETECTION LIMIT			BUTYLTIN SPECIES			PCB	CHLORINATED PESTICIDES	
	<u>Molecular Weight</u>			Tributyl	Dibutyl	Monobutyl		Total DDD, DDE, & DDT	Others
	Total Low	Total High	Total PAH						
COMP OB-3 (Berth 38)	506	1,622	2,128	25.1	2.3	2.1+	117	3.9	.5-.7 4 Pesticides
OB-3(b)	164	1,259	1,423	11.7	15.6	0.4U	184	5.3	Ux
OB-3(c)	49	320	369	1.3	0.6	0.5U	20U	0.5	0.5 aBHC
COMP IB-1 (Berth 60)	348	3,109	3,457	27.3*	8.4*	2.5*+	241	6.0	.6-1.1 4 Pesticides
IB-1(a)	31	333	364	3.8	1.8	0.4U	26	1.3	0.3 aBHC
IB-1(b)	285	2,261	2,546	8.3	5.0	2.4+	165	6.4	.6-1.0 4 Pesticides
COMP IB-2 (Berth 61)	86	934	1,020	6.6	1.5	8.9+	70	1.9	.3-.4 3 Pesticides
IB-2(a)	1	Ux	1	0.7	0.5U	0.5U	20U	Ux	.2-.3 2 BHCs
IB-2(b)	70	832	902	2.3	2.0	1.5+	60	1.6	.2-.3 3 Pesticides
COMP IB-3 (Berth 62-63)	91*	376*	467	1.5	0.7	0.5U	20U*	1.9*	2.8* Endo. sulf.
IB-3(a)	1	3	4	0.7	0.8	0.4U	20U	Ux	0.3 aBHC
IB-3(b)	2	3	3	0.8	0.5U	1.0+	20U	Ux	.2-.3 3 BHCs
IB-4(a)	4	40	44	0.8	0.5U	1.1+	20U	Ux	0.4 aBHC
IB-4(b)	2	8	10	0.7	3.9	2.4+	20U	Ux	Ux
IB-4(b) top 11"	318	2,658	2,976	18.1	8.1	2.5+	147	5.8	.6-1.1 4 Pesticides
COMP IB-SPP (all IBs)	125	1,045	1,170	10.5	3.0	2.2+	20U	1.9	.3-.4 3 Pesticides
REFERENCE SEDIMENTS									
R-AM (IIIA)	13*	21*	34	0.7U	0.6U	0.50U	25U*	Ux*	Ux*
R-AM (IIIA Repeat)	46	93	139	1.0+	1.6	0.6U	24U	2U	Ux
R-AM (IIIB)	374	1,246	1,620	1.1	1.0U	1.0U	20U	5.0U	Ux
R-AM (Berths)	158	511	669	0.8	0.6U	1.0+	20U	0.7	Ux
R-AM (Intensive)	1,372*	3,757*	5,129	0.8*	1.2U*	1.3U*	2.8U*	0.5*	0.5* Hept. epox.
R-OS (IIIA)	5	7	12	1.0U	1.0U	0.80U	25U	6U	Ux
R-OS (IIIA Repeat)	Ux	Ux	Ux	1.9+	1.0	0.8U	260	3U	Ux

Table A-3
Oakland Harbor -42 Foot Project
Butyltins, Total Polynuclear Aromatic Hydrocarbons (PAHs), PCBs, and Pesticides
(µg/kg Dry Weight)
(page 6 of 6)

<i>Sediment Treatment</i>	PAHS ABOVE DETECTION LIMIT			BUTYLTIN SPECIES			<i>PCB</i>	CHLORINATED PESTICIDES	
	<i>Total Low</i>	<i>Total High</i>	<i>Total PAH</i>	<i>Tributyl</i>	<i>Dibutyl</i>	<i>Monobutyl</i>		<i>Total DDD, DDE, & DDT</i>	<i>Others</i>
R-OS (IIIB)	11	6	17	1.0U	1.5	1.0U	20	5.0U	Ux
R-OS (Berths)	14	23	37	0.8U	0.7U	12.5+	20U	0.5	.4-.7 2 BHCs
R-OS (Intensive)	65	57	122	0.7U	1.2U	1.3U	2.8U	1.2	Ux

Notes:

- * mean of replicate sample analyses
- U concentration is less than given detection limit
- + analyte contaminated and concentration not corrected for amount of contamination in analyte
- ND no data, not analyzed for chemical(s)
- Ux concentration less than detection limit and detection limit varies by chemical.

(IIIA), (IIIB), (III38), (Berths), or (Intensive) refers to the Battelle testing phase for the sediment analysis report.

- not analyzed

Table A-4
Oakland Harbor -42 Foot Project
Toxicity Tests
(page 1 of 4)

Sediment Treatment	SUSPENDED PHASE (LC50 AS % OF SUSPENDED)			SOLID PHASE (% MEAN SURVIVAL)					
	Clam or Mussel Larvae }	Young Fish +	Shrimp @	Clam 10-day	Clam 28-day	Worm 10-day	Worm 28-day	Amphipod#	Young Fish +
INNER CHANNEL									
COMP I-C1-A (Intensive)	> 100	> 100	> 100	99.0	90.0	94.0	93.0	91.0	-
COMP I-C1-B (Intensive)	> 100	49.0	> 100	99.0	93.0	85.0	84.0	26.0*^	-
COMP I-C1-B Special	79.9	76.4	> 100	97.0	95.0	81.0*^	87.0	79.0*^	-
COMP I-C1-C (Intensive)	> 100	> 100	> 100	100	94.0	88.0	81.0	63.0*^	-
COMP AC-1 (IIIA)	-	-	-	100	95	83.4	82	91.0	86
I-C2 (IIIB)	-	-	-	-	99.2	98.0	93.3	59.0*^	98.0
I-C3 (IIIA Repeat)	-	-	-	100	99.0	90.0	91.2	96.0	-
I-C3 (IIIB)	-	-	-	-	100	100	98.0	-	96.0
I-C4 (IIIA)	-	-	-	96.8	94	66.0	75	84.0	90.0
I-C4 (IIIB)	-	-	-	-	97.6	95.0	92.7	-	-
I-C5 (IIIA)	-	-	-	99.2	99	69.0	47	94.0	100
I-C5 (IIIA Repeat)	-	-	-	99.0	96.0	79.0	86.2	-	-
I-C7 (IIIA)	-	-	-	99.2	99	91.4	92	77.0	92.0
I-C7 (IIIA Repeat)	-	-	-	100	100	87.0	88.4	-	-
I-C8 (IIIA)	-	-	-	88.0^	86	64.8	69	65.0^	85.0
I-C8 (IIIA Repeat)	-	-	-	100	79.0	74.0^	74.6	-	-
I-C8 (IIIB)	-	-	-	-	96.8	93.0	86.7	89.0	97.5
BC-4 (IIIA)	91.9	> 100	> 100	-	-	-	-	-	-
I-C9 (IIIA)	-	-	-	97.0	90	86.6	79	50.0^	92.0
I-C9 (IIIA Repeat)	-	-	-	100	96.8	80	78.0	-	-
I-C10 (IIIA)	-	-	-	99.2	91	92.2	86	91.0	90.0
I-C10 (IIIA Repeat)	-	-	-	98.0	100	71.0^	84.6	-	-
I-C11 (IIIA)	-	-	-	96.8	97	92.6	92	92.0	90.0
I-C11 (IIIA Repeat)	-	-	-	99.0	98.4	70.0^	73.2	-	-
I-C12 (IIIA)	-	-	-	100	98	96.6	97	82.0	100
I-C12 (IIIA Repeat)	-	-	-	100	99.0	78.0^	80.6	-	-
BC-3 (IIIA)	> 100	> 100	> 100	-	-	-	-	-	-

Table A-4
Oakland Harbor -42 Foot Project
 Toxicity Tests
 (page 2 of 4)

<i>Sediment Treatment</i>	SUSPENDED PHASE (LC50 AS % OF SUSPENDED)			SOLID PHASE (% MEAN SURVIVAL)					
	<i>Clam or Mussel</i>	<i>Young</i>	<i>Shrimp @</i>	<i>Clam</i>	<i>Clam</i>	<i>Worm</i>	<i>Worm</i>	<i>Amphipod#</i>	<i>Young Fish +</i>
	<i>Larvae }</i>	<i>Fish +</i>		<i>10-day</i>	<i>28-day</i>	<i>10-day</i>	<i>28-day</i>		
I-C14 (IIIA)	-	-	-	96.0	96.0	87.4	86	79.0	100
I-C14 (IIIA Repeat)	-	-	-	100	96	64.0^	83.4	-	-
I-C15 (IIIA)	-	-	-	99.2	94	90.6	87	86.0	92.0
I-C15 (IIIA Repeat)	-	-	-	99.0	94.4	46.0*^	44.6	-	-
I-C16 (IIIA)	-	-	-	100	95	82.8	73	76.2	90.0
I-C16 (IIIA Repeat)	-	-	-	100	98.4	31.0*^	30.8	-	-
I-C17 (IIIA)	-	-	-	100	85	81.8	79	49.0^	94.2
I-C17 (IIIA Repeat)	-	-	-	100	96.8	45.0*^	56.6	-	-
I-C18 (IIIA)	-	-	-	99.2	95	54.6	65	91.0	86.0
I-C18 (IIIA Repeat)	-	-	-	99.0	96.8	39.0*^	38.6	-	-
Comp III (III38)	> 100	> 100	> 100	100	95.0	69.0	84.0	83.0	96.0
Comp VI (III38) [I-C35]	> 100	> 100	> 100	98.0	99.0	62.0	74.0	72.0	92.0
OUTER CHANNEL									
COMP AC-3 (IIIA)	-	-	-	100	96	87.2	86	84.0	88
BC-7 (IIIB)	> 100	> 100	> 100	-	-	-	-	-	-
O-C13 (IIIB)	-	-	-	-	96.0	85.0*^	86.0	94.0	94.0
O-C12 (IIIB)	-	-	-	-	96.0	91.0	84.7	68.0^	100
O-C11 (IIIB)	-	-	-	-	97.6	86.0*^	88.7	93.0	98.0
O-C10 (IIIB)	-	-	-	-	96.0	93.0	90.7	92.0	96.0
BC-5 (IIIB)	> 100	> 100	> 100	-	-	-	-	-	-
O-C9 (IIIB)	-	-	-	-	96.8	99.0	93.3	70.0^	100.0
O-C8 (IIIB)	-	-	-	-	96.8	90.0	88.0	88.0	100.0
O-C7 (IIIB)	-	-	-	-	97.6	82.0*^	92.0	86.0	100.0
O-C6 (IIIB)	-	-	-	-	88.8	93.0	93.3	93.0	94.0
BC-8 (IIIB)	> 100	> 100	> 100	-	-	-	-	-	-
O-C5 (IIIB)	-	-	-	-	96.8	98.0	92.7	85.0	100
O-C4-A (IIIB)	-	-	-	-	97.6	95.0	93.3	84.0	98.0

Table A-4
Oakland Harbor -42 Foot Project
 Toxicity Tests
 (page 3 of 4)

<i>Sediment Treatment</i>	SUSPENDED PHASE (LC50 AS % OF SUSPENDED)			SOLID PHASE (% MEAN SURVIVAL)					
	<i>Clam or Mussel</i>	<i>Young</i>	<i>Shrimp @</i>	<i>Clam</i>	<i>Clam</i>	<i>Worm</i>	<i>Worm</i>	<i>Amphipod#</i>	<i>Young Fish+</i>
	<i>Larvae }</i>	<i>Fish+</i>		<i>10-day</i>	<i>28-day</i>	<i>10-day</i>	<i>28-day</i>		
COMP O-C4-B (Intensive)	>100	>100	>100	99.0	94.0	91.0	89.0	98.0	-
BC-6 (IIIB)	>100	>100	>100	-	-	-	-	-	-
O-C3 (IIIB)	-	-	-	-	98.4	95.0	92.0	81.0	100
O-C1 (IIIB)	-	-	-	-	100	87.0*^	91.8	47.0*^	98.0
I-C2 (IIIB)	-	-	-	-	99.2	98.0	93.3	59.0*^	98.0
O-C2 (IIIB)	-	-	-	-	99.2	98.0	88.6	67.0^	100
TURNING BASIN WINGS									
I-S1 (IIIA)	-	-	-	96.0	93	68.0	74	71.0^	90.0
I-S1 (IIIA Repeat)	-	-	-	100	96.8	73.0^	82.0	-	-
I-T1 (IIIA)	-	-	-	99.2	96	70.0	67	89.0	95.0
I-T1 (IIIA Repeat)	-	-	-	99.0	96.0	69.0^	78.0	-	-
I-T3 (IIIA)	-	-	-	99.2	94	72.0	71	87.0	83.3
I-T3 (IIIA Repeat)	-	-	-	99.0	96.8	57.0*^	75.4	-	-
I-T5 (IIIA)	-	-	-	100	97	70.0	69	88.0	93.3
I-T5 (IIIB)	-	-	-	-	98.4	93.0	92.7	-	-
BERTHS									
COMP OB-1 (Berth 25)	>100	>100	>100	100	96.8	96.0	89.3	88.0	98.0
COMP OB-2 (Berths 32-34)	65.3	>100	87.5	98.2	96.8	90.0	87.3	90.0	96.0
COMP OB-3 (Berth 38)	31.5	>100	65.1	98.0	97.4	83.0	88.0	87.0	96.0
COMP IB-1 (Berth 60)	-	-	-	99.0	98.4	73.0*^	77.3	72.0	98.0
COMP IB-2 (Berth 61)	-	-	-	98.0	92.0	73.0*^	90.0	86.0	98.0
COMP IB-3 (Berths 62-63)	-	-	-	100	95.2	88.0	94.7	87.0	96.0
Comp IB-SPP (all IH berths)	58.4	>100	>100	-	-	-	-	-	-

Table A-4
Oakland Harbor -42 Foot Project
Toxicity Tests
(page 4 of 4)

Sediment Treatment	SUSPENDED PHASE (LC50 AS % OF SUSPENDED)			SOLID PHASE (% MEAN SURVIVAL)					
	Clam or Mussel	Young	Shrimp @	Clam	Clam	Worm	Worm	Amphipod#	Young Fish +
	Larvae }	Fish +		10-day	28-day	10-day	28-day		
REFERENCE SEDIMENTS									
R-AM (IIIA)	-	-	-	99.2	98	52.5	64	93.0	85.0
R-AM (IIIA Repeat)	-	-	-	100	99.2	92.0	96.2	-	-
R-AM (IIIB)	>100	>100	>100	-	99.2	99.0	99.3	98.0	100
R-AM (Berths)	>100	>100	>100	98.0	95.2	83.0	96.0	90.0	100
R-AM (Intensive)	>100	>100	>100	96.0	94.0	92.0	93.0	96.0	-
R-OS (IIIA)	-	-	-	97.0	90	93.0	97	63.0	-
R-OS (IIIA Repeat)	-	-	-	99.0	96.0	78.2	92.6	-	-
R-OS (IIIB)	-	-	-	-	96.0	99.0	92.7	83.0	100
R-OS (Berths)	-	-	-	97.0	92.8	93.0	92.7	86.0	98.0
R-OS (Intensive)	>100	>100	>100	98.3	83.0	96.7	94.0	97.0	-

Notes: } Clam (*Crassostrea gigas*) larvae were used for IIIA and Berths phases of testing and mussel (*Mytilus edulis*) larvae for the IIIB and Intensive phases.

 + Juvenile speckled sanddab (*Citharichthys stigmaeus*)

 @ The mysid shrimp *Holmesimysis sculpta* (no common name)

 \$ *Nephtys caecoides* (no common name)

 # *Rhepoxynius abronius* (no common name)

 - test not done

 * Mortality is more than 10% (>20% for amphipod) higher in treatment sediment than in R-OS reference sediment. Sediment is potentially unsuitable for ocean disposal according to Greenbook criteria. Amphipod mortality for the I-C1-B Special was proven to be due to ammonia toxicity and low salinity in the sediments, not toxic concentrations of contaminants.

 ^ Mortality is more than 10% (>20% for amphipod) higher than in R-AM reference sediment.

TABLE 5
OAKLAND HARBOR -42 FOOT PROJECT
OCEAN DISPOSAL BIOACCUMULATION TESTS SUMMARY

Sediment Treatments	Significant Bioaccumulation		Bioaccumulation $\geq 2 < 5$ times		Bioaccumulation $\geq 5 < 10$ times		Bioaccumulation ≥ 10 times	
	# of LPAH compounds (6-7 possible)	# of HPAH compounds (10 possible)	# of Pesticide compounds (18-20 possible)	# of PCB compounds (4-7 possible)	# of Metals compounds (10 possible)	# of Butyltin compounds (2 possible)	# of LPAH compounds (6-7 possible)	# of HPAH compounds (10 possible)
O-C13	2	2	4	1	1	1		
O-C12			3					
O-C11	2	1	4	1	1	1		
O-C10	1	2	6	1	1		1	
O-C9	1		3	1	1			
O-C8	2	1	4	1	2	1		1
O-C7	2	2	2	1	1	1		
O-C6	1	2	6	1	1	1		
O-C5	1		2	1	1	1		
O-C4			6	1	1	1		2
O-C3	1		1	2	1			
O-C2	1		1	1	1			
O-C1	1		1	1	1	1		
I-C2 (III B)	1		1	2	1	1		
I-C3 (III A)	1				1			
I-C3 (III B)	1		1					
I-C4			1	4	1	1		
I-C5	1		1	1	1			
I-C7	1	1		1	1	1		
I-C8 (III A)	1				1			
I-C8 (III B)	1	2	1	1	2	1		
I-C9	1	1	3	1	1	2	1	
I-C10	6	1	1	1	1	2	2	1
I-C11	2		2	1	1	1	2	
I-C12	1	1		1				1
I-C14			3	1	2			
I-C15	1	1		2	1	1		1
I-C16	1		1	1	1			
I-C17		1	2	2	1	1		
I-C18	1	1		1	1	1	1	
I-S1	3	5	1	2	1	1	1	4
I-T1	1	6	1	3	1	1	1	4
I-T3	1	7	1	1	1	1	3	3
I-T5	5		4	2	1	1	2	1
COMP OB-1	1	7	1	1	1	2	2	2
COMP OB-2	1	7	1	1	2	1	6	1
COMP OB-3	2	7	3	1	1	2	1	1
COMP IB-1	2	6	2	1	1	2	1	1
COMP IB-2	2	9	2	1	2	2	1	1
COMP IB-3	2	9	3	1	2	1	1	1
COMP IB-SPP	2	9	3	1	2	1	1	1
COMP IC1-A		1	2		1			
COMP IC1-B			2	2				
COMP IC1-B Special	1	1	1	2	3	1	1	
COMP IC1-C	2	1	1	1	3	2	1	
COMP OC4-B	1	5	3	2	1	1	2	1

 Number of Compounds Bioaccumulating in *M. nasuta* Tissues
 Number of Compounds Bioaccumulating in *N. caecoides* Tissues

TABLE 6
OAKLAND HARBOR -42 FOOT PROJECT
ALCATRAZ DISPOSAL BIOACCUMULATION TEST SUMMARY

Sediment Treatments	Significant Bioaccumulation					Bioaccumulation ≥ 2 < 5 times					Bioaccumulation ≥ 5 < 10 times					Bioaccumulation ≥ 10 times				
	# of LPAH compounds (6-7 possible)	# of HPAH compounds (10 possible)	# of Pesticide compounds (18-20 possible)	# of PCB compounds (4-7 possible)	# of Metals compounds (10 possible)	# of Butyltin compounds (2 possible)	# of LPAH compounds (6-7 possible)	# of HPAH compounds (10 possible)	# of Pesticide compounds (18-20 possible)	# of PCB compounds (4-7 possible)	# of Metals compounds (10 possible)	# of Butyltin compounds (2 possible)	# of LPAH compounds (6-7 possible)	# of HPAH compounds (10 possible)	# of Pesticide compounds (18-20 possible)	# of PCB compounds (4-7 possible)	# of Metals compounds (10 possible)	# of Butyltin compounds (2 possible)		
O-C13	1	2		2	3		1	1					1							
O-C12				3	2					2										
O-C11	1	1		1	3			1		1										
O-C10	2	2	1	1	4		1	1		2										
O-C9	1			1	1		1													
O-C8	1	1	1	3	3			1		2										
O-C7				1	3															
O-C6	1			1	3		1													
O-C5	1			2	3		1													
O-C4				1	6					2						1		1		
O-C3	1			5	1		1			4										
O-C2				7	1					3										
O-C1	1			7	1		1			3					1					
I-C2 (III B)				7	1					4										
I-C3 (III A)																				
I-C3 (III B)				7	1					4										
I-C4				2	3					1										
I-C5				2	3					1										
I-C7	1			1	1					1										
I-C8 (III A)				2	1					1										
I-C8 (III B)	2	1		7	1		1			4										
I-C9	1			3	1		1			2			1							
I-C10	6	1		2	1		1			1		4				1	1			
I-C11				3	2	1				2	1									
I-C12	1			1	1					1						1				
I-C14				2	2					2	1									
I-C15	1	1		2	1	2	1		1	1	2	1								
I-C16	1			2	1					1										
I-C17	1			1	1		1			1										
I-C18				1	2	1				1	1	1								
I-S1	1	6	4	2	1		1			2	2				1	4	2			
I-T1	6	2		2	2		1	2		1					3	2				
I-T3	7	2		3	1	1	2	1		3	1	1	1		4	1		1		
I-T5	4			2	1		1			2			1		1	2				
COMP OB-1	3	1		1	1		1			1	1					1				
COMP OB-2	1	2		1	1										1					
COMP OB-3	3	7	1	1	2	2	1	5	1	1		1	1		1	1	1			
COMP IB-1	1	9	1	1	2			4	1	1			3	2		1	1			
COMP IB-2	1	9	1	1	2			6	2	1	1		1			1	1			
COMP IB-3	1	9	1	1	2		1	6					3	2			1	1		
COMP IB-SPP																				
COMP IC1-A				2	1					1										
COMP IC1-B				2	1					2										
COMP IC1-B Special				3	2					1										
COMP IC1-C				2	2					1										
COMP OC4-B		4	1	2	1			3	1	1										

 Number of Compounds Bioaccumulating in *M. nasuta* Tissues
 Number of Compounds Bioaccumulating in *N. caecoides* Tissues

Table A-7
Oakland Harbor -42 Foot Project: Turning Basin Wings
Conventional Sediment Measurements (Grain Size, TOC and TVS (in percent dry weight);
Oil and Grease and TPH (in mg/kg dry weight)
(page 1 of 3)

<i>Sediment Treatment</i>	<i>Sampling Depth (feet below MLLW)</i>	<i>Sand 62.5- 2,000 µm</i>	<i>Silt 3.9- 62.5 µm</i>	<i>Clay < 3.9 µm</i>	<i>TOC</i>	<i>TVS</i>	<i>Oil and Grease</i>	<i>TPH</i>	<i>Sediment Analysis Report</i>
SCHNITZER WING									
B3A	to 38	--	--	--	--	--	65.2U	5.4	Wood. 1988
I-S1 (IIIA)	to 44	1.98*	30.16*	67.77*	0.92	7.57	45.89	22.37	Batt. 9/1992
I-S1 (IIIA Repeat)	to 44	4	30	66	1.16	7.26	344	267	Batt. 9/1992
S1	to 42	5	30	65	1.90	--	271	--	COE 1988
S2	to 42	33	27	40	1.50	--	1056	--	COE 1988
S3	to 44	7	35	58	2.60	--	673	--	COE 1988
SN1	to 36.0	9.06	38.28	52.57	1.76	--	265.0	86.7	Batt. 1988
SN2U	to 34.5	4.65	39.78	55.58	2.02	--	751.1	263.5	Batt. 1988
SN2L	34.5 to 37.8	13.66	34.10	53.05	2.13	--	739.7	507.8	Batt. 1988
SN3U	to 39.6	21.63	30.63	47.80	1.58	--	755.4	239.4	Batt. 1988
SN3L	38.5 to 42.5	22.84	32.36	44.84	1.51	--	308.0	244.3	Batt. 1988
OI-SS1U	to 38	3.00	30.26	66.79	1.48*	--	440	311	Batt. I 1990
OI-SS1L	38 to 44	47.58	14.40	37.77	0.94*	--	932	717	Batt. I 1990
OI-SS2L	38 to 44	22.29	24.84	52.55	1.21	--	612	445	Batt. I 1990
OI-SS3L	38 to 44	20.11	25.89	54.75	1.29	--	2,004	2,082	Batt. I 1990
OI-SS4L	38 to 44	88.05*	8.56*	3.37*	0.01	--	20U	20U	Batt. II 1990
OI-SS5L	38 to 44	10.01	27.98	62.00	1.29	--	436	337	Batt. I 1990

Table A-7
Oakland Harbor -42 Foot Project: Turning Basin Wings
Conventional Sediment Measurements (Grain Size, TOC and TVS (in percent dry weight);
Oil and Grease and TPH (in mg/kg dry weight)
(page 2 of 3)

<i>Sediment Treatment</i>	<i>Sampling Depth (feet below MLLW)</i>	<i>Sand 62.5- 2,000 um</i>	<i>Silt 3.9- 62.5 um</i>	<i>Clay < 3.9 um</i>	<i>TOC</i>	<i>TVS</i>	<i>Oil and Grease</i>	<i>TPH</i>	<i>Sediment Analysis Report</i>
TODD WING									
B4A	to 37.8	—	—	—	—	—	65.2U	47.8	Wood. 1988
B5A	to 37.5	—	—	—	—	—	65.2U	2.4	Wood. 1988
Station 1	to 34.5	43.80	31.90	24.30	0.13	—	110	—	HLA 1989
Station 4	to 32.7	—	—	—	0.82	—	—	—	HLA 1989
I-T1 (IIIA)	to 44	2.24	36.27	61.39	1.22*	10.08 *	178.35	159.6 1	Batt. 9/1992
I-T1 (IIIA Repeat)	to 44	3	34	63	1.33	9.40	190	148	Batt. 9/1992
I-T3 (IIIA)	to 42.08*	87.11	5.55	7.29	0.05	1.62	37.61	11.96	Batt. 9/1992
I-T3 (IIIA Repeat)	to 44	86	5	9	0.14	1.90	80	59	Batt. 9/1992
I-T5 (IIIA)	to 40.38*	83.80*	4.58*	11.40*	0.09	1.88	15.01	14.10	Batt. 9/1992
I-T5 (IIIB)	to 37.7	85	4	11	0.01	1.38	130	106	Batt. 6/1992
T4	to 44	62	13	25	0.80	—	399	—	COE 1988
T5	to 44	22	24	54	2.00	—	1136*	—	COE 1988
T6	to 38	42	20	38	1.60	—	1031	—	COE 1988
T7	to 35	28	27	45	1.40	—	414	—	COE 1988
TD1U	to 27.9	27.17	30.62	41.47	1.46	—	503.8	399.8	Batt. 1988
TD1L	26.2 to 29.3	33.88	26.22	39.80	1.89	—	1,040.7	387.0	Batt. 1988
TD2U	to 29.5	10.24	36.55	53.25	1.65	—	499.3	279.3	Batt. 1988
TD2L	28.3 to 32.8	33.62	27.08	38.91	1.61	—	781.6	275.2	Batt. 1988
OI-TS1U	to 38	17.64	29.37	53.19	1.13	—	398	273	Batt. I 1990

Table A-7
Oakland Harbor -42 Foot Project: Turning Basin Wings
 Conventional Sediment Measurements (Grain Size, TOC and TVS (in percent dry weight);
 Oil and Grease and TPH (in mg/kg dry weight)
 (page 3 of 3)

<i>Sediment Treatment</i>	<i>Sampling Depth (feet below MLLW)</i>	<i>Sand 62.5- 2,000 um</i>	<i>Silt 3.9- 62.5 um</i>	<i>Clay < 3.9 um</i>	<i>TOC</i>	<i>TVS</i>	<i>Oil and Grease</i>	<i>TPH</i>	<i>Sediment Analysis Report</i>
OI-TS1L	38 to 44	14.58	32.41	52.86	1.23	—	72	32	Batt. I 1990
OI-TS4U	to 29.5	35.72	19.17	44.01	1.04	—	1,160	930	Batt. I 1990
OI-TS5U	to 38	8.70	35.96	59.80	1.31	—	1,437	1,030	Batt. I 1990
OI-TS5L	38 to 44	37.34	20.56	37.60	1.25*	—	1,295	982	Batt. I 1990
OI-TS5AU	to 38	29.39*	34.59*	35.27*	1.06*	—	1,152*	951	Batt. II 1990
OI-TS5AL	38 to 44	83.03	8.85	7.51	0.13	—	147	110	Batt. II 1990
OI-TS5A Merritt	~ 43 to 44	90.76	6.69	2.45	0.01	—	20U	20U	Batt. II 1990

Notes: * mean of replicate measurements
 — not analyzed

TABLE A-8
Oakland Harbor -42 Foot Project: Turning Basin Wings
Sediment Metals (mg/kg dry weight)

Treatment	Ag	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
SCHNITZER WING										
B3A@	0.57	20.87	6.96	69.57	56.52	0.283	71.7	73.91	6.07	147.83
I-S1 (IIIA)	0.271	9.90	0.460	208	63.1	0.257	132.8	29.6	0.22U	151.3
I-S1 (IIIA Repeat)	0.59	10.40	0.76	204	86.1	0.812	126.1	65.3	0.38	222.0
S1	0.45	10.6	1.42	230.0	71.1	0.41	129.0	48.4	0.38	179.0
S2	0.57	7.10	1.97	343.0	79.0	1.30	101.0	100.0	0.16	260.0
S3	0.63	10.5	1.05	217.0	81.40	0.76	130.0	87.60	0.23	208.0
SN1	0.874	14.9	0.77	245.6	87.0	0.659	131.2	68	0.54	232
SN2U	0.940	15.3	0.99	238.2	90.6	0.777	125.8	90	0.68	269
SN2L	1.117	14.1	1.67	279.6	111.4	1.484	132.4	141	0.59	347
SN3U	0.680	13.9	0.81	252.9	76.2	0.652	124.5	69	0.54	211
SN3L	0.813	14.9	1.09	277.0	77.6	1.111	124.5	86	0.68	234
OI-SS1U	0.81	12.50	1.13	203	105.2	0.828	117.7	99.3	0.59	275.0
OI-SS1L	0.50	9.50	1.57	398	82.3	1.321	94.9	156.7	0.68	330.0
OI-SS2L	0.62	12.20	0.84	243	78.9	0.649	111.3	68.8	0.55	203.0
OI-SS3L	0.99	14.40	1.51	258	127.7	3.420	113.5	106.8	1.00	280.0
OI-SS4L	0.04*	3.55	0.02*	578.0	11.0	0.028*	57.3	7.1	0.13*	43.2
OI-SS5L	0.52	14.10	0.63	229	87.9	0.590	122.0	59.6	0.43	200
TODD WING										
B4A@	0.80	20.87	7.39	110.9	113.0	0.239	71.7	73.9	1.20	165.2
B5A@	0.83	28.9	8.0	82.6	63.0	0.30	73.9	69.6	1.20	139.1
Station 1	0.1U	13.4	0.2U	104	104	0.56	77.9	64.6	0.33	158
Station 4	0.2U	11	0.2U	112	94	0.78	82	73	0.42	161
I-T1 (IIIA)	0.629*	12.93*	0.385 *	209*	80.7*	0.524*	122.1*	52.3*	0.22U	188.4*
I-T1 (IIIA Repeat)	0.50*	12.50*	0.35*	233*	83.6*	0.476*	120.8*	52.5*	0.36*	183.6*
I-T3 (IIIA)	0.067	4.35	0.093	687	15.3	0.067	68.9	9.0	0.22U	53.5
I-T3 (IIIA Repeat)	0.10	3.96	0.12	564	26.3	0.173	62.9	17.3	0.07U	65.9

TABLE A-8
Oakland Harbor -42 Foot Project: Turning Basin Wings
Sediment Metals (mg/kg dry weight)

Treatment	Ag	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
I-T5 (IIIA)	0.093	4.94	0.099	455	20.9	0.086	69.3	10.9	0.22U	56.5
I-T5 (IIIB)	0.026	3.12	0.09	314	14.5	0.031#	68.7	5.3	0.11U	43.5
T4	0.33	5.90	0.67	416.0	96.70	1.30	85.70	78.30	0.08	183.0
T5	1.00	16.30	2.02	390.0	326.0	8.30	146.0	177.0	0.31	428.0
T6	0.62	13.30	1.16	930.0	423.0	4.20	212.0	246.0	0.23	549.0
T7	0.70	9.20	1.33	437.0	224.0	2.70	155.0	174.0	0.31	287.0
TD1U	0.783	12.3	0.70	371.7	183.3	1.345	132.4	80	0.63	234
TD1L	0.837	13.5	1.16	352.5	178.5	1.060	135.0	109	0.54	471
TD2U	0.768	15.3	0.60	268.4	132.1	0.973	135.0	79	0.59	232
TD2L	0.857	14.1	0.82	425.0	178.5	1.823	153.5	90	0.45	287
OI-TS1U	0.70	16.10	0.91	395	153.3	0.819	132.0	88.4	0.54	231.0
OI-TS1L	0.85	13.40	0.89	433	258.0	1.135	147.1	127.0	0.42	294.0
OI-TS4U	0.63	8.70	0.95	642	139.5	2.009	173.0	216.0	0.48	379.0
OI-TS5U	0.71	12.20	0.76	458	183.1	1.221	161.0	145.9	0.48	330.0
OI-TS5L	0.62*	13.45*	1.16*	2170*	470.5*	6.115*	391.0*	487.0*	0.29*	476.5*
OI-TS5AU	0.81*	9.70	1.02*	444.0	261.0	14.525*	111.5	147.1	0.45*	326.0
OI-TS5AL	0.14	4.84	0.17	439.0	21.7	0.426	58.9	24.6	0.18	68.9
OI-TS5A Merritt	0.04	3.22	0.02	552.0	10.7	0.045	57.3	7.0	0.14	43.9

Notes: * mean of replicate measurements

concentration from reanalysis of archived sample.

@ values reported as wet weights. Converted to dry weights using the 46% mean solids value Woodward used (Tab F-1) for making comparisons.

TABLE A-9
Oakland Harbor -42 Foot Project: Turning Basin Wings
Butyltins, Total Polynuclear Aromatic Hydrocarbons (PAHs), PCBs and Pesticides
($\mu\text{g/kg}$ dry weight)
(page 1 of 3)

Sediment Treatment	PAHS ABOVE DETECTION LIMIT			BUTYLTIN SPECIES			CHLORINATED PESTICIDES		
	Molecular Weight		Total PAH	Tri- butyl	Di- butyl	Mono- butyl	PCB	Total DDD, DDE & DDT	Others
	Total Low	Total High							
SCHNITZER WING									
B3A@	435U	435U	435U	--	--	--	22U	22U	Ux
I-S1 (IIIA)	288	1,032	1,320	3.20+	1.50	0.97	28	10U	Ux
I-S1 (IIIA Repeat)	606	5,773	6,379	17.5+	12.9	2.5	97	4.0U	Ux
S1	390	5,270	5,660	30.5*	33.0*	83.3*	90	4.0U	Ux
S2	930	12,470	13,400	19.4	13.1	334.2	250	4.0U*	Ux*
S3	560	17,190	17,650	16.6	15.6	43.4	220	4.0U	Ux
SN1	160	2,600	2,760	73.6	39.6	5.53	80	10U	Ux
SN2U	575	7,700	8,275	96.3	67.8	9.28	280	10U	Ux
SN2L	1,490	14,390	15,880	50.7	51.4	2.98U	780	10U	Ux
SN3U	430	7,180	7,610	105	45.8	8.21	90	10U	Ux
SN3L	430	10,230	10,660	37.1	35.2	10.5	110	10U	Ux
OI-SS1U	825	10,353	11,179	41*	23.0*	14U	582.5	38.1	Ux
OI-SS1L	12,879	23,140	37,019	8.4*	5.5U*	6U*	726.6	31	Ux
OI-SS2L	448	5,323	5,771	51	38	11U	215.7	18	Heptachlor e. 2.0
OI-SS3L	1,470	13,168	14,638	34	7U	7.6U	444.2	13	Heptachlor 3.0
OI-SS4L	4.66	22.88	27.54	0.57U	0.32U	0.85U	4U	4.0U	Ux
OI-SS5L	907	8,141	9,049	28	12U	5.5U	113.6	12	Endosulfan I 3.0
TODD WING									
B4A@	435U	435U	435U	--	--	--	22U	22U	Ux
B5A@	435U	435U	435U	--	--	--	22U	22U	Ux

TABLE A-9
Oakland Harbor -42 Foot Project: Turning Basin Wings
Butyltins, Total Polynuclear Aromatic Hydrocarbons (PAHs), PCBs and Pesticides
(µg/kg dry weight)
(page 2 of 3)

<i>Sediment Treatment</i>	PAHs ABOVE DETECTION LIMIT		BUTYLTIN SPECIES				CHLORINATED PESTICIDES		
	Molecular Weight		<i>Total PAH</i>	<i>Tri- butyl</i>	<i>Di- butyl</i>	<i>Mono- butyl</i>	<i>PCB</i>	<i>Total DDD, DDE & DDT</i>	<i>Others</i>
	<i>Total Low</i>	<i>Total High</i>							
Station 1	42U	45.8	45.8	3000	--	--	194	1.3U	Endo 13, Hepta.e. 0.42
Station 4	42	202	244	1200	--	--	37	--	0.42U a&b BHC only
I-T1 (IIIA)	194	2,421	2,615	34.20	30.00	5.80	66	12U	Ux
I-T1 (IIIA Repeat)	260	3,293	3,499	29.2+	18.6	5.8	140	4.0U	Ux
I-T3 (IIIA)	22	380	402	12.00+	8.70	1.50	26	6U	Ux
I-T3 (IIIA Repeat)	105	1,212	1,317	64.3+	27.4	3.5	400	3.0U	Ux
I-T5 (IIIA)	32	528	560	48.00	18.00	4.30	40U	6U	Ux
I-T5 (IIIB)	Ux	Ux	Ux	1.0U	1.0U	1.0U	20U	5.0U	Ux
T4	250	8,890	9,140	58.8	25.1	7.5	490	4.0U	Ux
T5	2,860	26,960	29,820	1.7U	2.4U	2.1U	670	4.0U*	Ux*
T6	1,840	29,130	30,970	180	22.3	37.1	1,370	8.0U	Ux
T7	440	7,210	7,650	582*	138.6*	51.0*	1,440	8.0U*	Ux*
TD1U	370	5,050	5,420	1,601	422	69.1	450	10U	Ux
TD1L	240	3,930	4,170	2,214	658	139	490	10U	Ux
TD2U	590	8,940	9,530	235	70.6	12.4	140	10U	Ux
TD2L	407	5,700	6,107	603	156	51.1	670	10U	Ux
OI-TS1U	915	9,155	10,070	700	81	49	480.0	5.4	Ux
OI-TS1L	1,533	9,577	11,110	2,600	640	100	979.2	5.66	Ux
OI-TS4U	1,245	19,356	20,602	264	2.9	5.1U	1,425.4	27	Dield 15.0, Hepta. 4.0

TABLE A-9
Oakland Harbor -42 Foot Project: Turning Basin Wings
Butyltins, Total Polynuclear Aromatic Hydrocarbons (PAHs), PCBs and Pesticides
(µg/kg dry weight)
(page 3 of 3)

<i>Sediment Treatment</i>	PAHs ABOVE DETECTION LIMIT		BUTYLtin SPECIES				CHLORINATED PESTICIDES		
	Molecular Weight		<i>Total PAH</i>	<i>Tri- butyl</i>	<i>Di- butyl</i>	<i>Mono- butyl</i>	<i>PCB</i>	<i>Total DDD, DDE & DDT</i>	<i>Others</i>
	<i>Total Low</i>	<i>Total High</i>							
OI-TSSU	2,018	27,461	29,479	492	181	44	1,430.5	4	Ux
OI-TSSL	7,409	24,284	31,693	120.5*	5.7U*	6.2U*	3,518.9	21	Heptachlor 7.0
OI-TSSAU	984.3	9,497.7	10,482	211.00	57.00	11.00	525.5	11.76	gBHC 2.28
OI-TSSAL	214.6	857.9	1,072. 5	2.30	0.32U	0.86U	54.1	1.96	gBHC 1.84
OI-TSSA Merritt	4.34	14.34	18.68	0.58U	0.32U	0.87U	4.0U	0.04U	Ux

Notes: U below detection limit
Ux below detection limit, limits varies with chemical
- not analyzed
@ values reported as wet weights, converted to dry weights using 46% as the mean solids value
* mean of replicate measurements
+ analyte contaminated and concentration not corrected for amount of contamination in analyte

TABLE 10
OAKLAND HARBOR -42 FOOT PROJECT
MERRITT FORMATION SEDIMENT ANALYSIS RESULTS
Conventional Sediment Measurements (grain size, TOC and TVS
in percent dry weight; Oil and Grease and TPH in mg/kg dry weight).

Sediment Treatment	Gravel > 2000um	Sand 62.5- 2000um	Silt 3.9- 62.5um	Clay < 3.9um	TOC	TVS	Oil and Grease	TPH
OB-1(a)	0	80	11	9	0.11	1.02	1.1U	1.1U
OB-1(c)	0	89	6	5	0.02	0.95	1.2U	1.2U
IB-2(a)	0	95	2	3	0.03	0.78	1.2U	1.2U
IB-3(b)	0	89	5	6	0.04	0.96	1.2U	1.2U
CH-4	0.56	90.60	1.57	7.26	0.10	—	19	30
MS-1	0.27	89.41	5.58	6.19	0.01	—	11	23
MS-1 Dup	—	—	—	—	—	—	—	—
MS-2	0.16	93.00	3.49	4.84	0.04	—	12	10
OO-CH-1	0.64	5.14	53.49	40.73	0.68	—	20U	20U
OI-CH-4A	0	90.19	6.83	2.97	0.02	—	20U	20U
OI-CH-6A	0.28	85.39	8.57	5.75	0.03	—	20U	20U
OO-W-5	0	88.50	7.87	3.63	0.04	—	20U	20U
OI-TS-5 Merritt	0.12	90.76	6.69	2.45	0.01	—	20U	20U

Sediment Treatment	Sediment Metals (mg/kg dry weight)									
	Metals									
	Ag	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
OB-1(a)	0.023	3.11	0.08	586	12.1	0.009	65.8	5.7	0.13	44.4
OB-1(c)	0.019	3.19	0.06	384	10.7	0.007	57.6	6.7	0.2	36.0
IB-2(a)	0.015	2.87	0.07	414	10.5	0.003	49.1	5.4	0.12U	37.3
IB-3(b)	0.036	2.93	0.18	823	13.8	0.007	54.9	7.2	0.12U	46.2
CH-4	1.08	4.56	0.08	634	14.9	0.050	58.4	8.6	0.10	50.6
MS-1	0.03U	3.07	0.06U	345	12.0	0.026	67.6	7.8	0.22	43.0
MS-1 Dup	0.03U	4.28	0.06U	325	11.0	0.030	62.6	7.7	0.19	41.3
MS-2	0.03U	4.02	0.06U	710	9.5	0.022	62.2	5.0	0.07	48.5
OO-CH-1	0.13	12.60	0.20	214	43.8	0.088	117.1	10.4	0.42	100.5
OI-CH-4A	0.05	3.31	0.02	164	10.8	0.023	41.7	7.6	0.18	33.7
OI-CH-6A	0.04	6.08	0.05	669	14.4	0.018	65.7	3.5	0.18	50.5
OO-W-5	0.04	3.55	0.02	408.0	8.9	0.070	57.9	7.4	0.22	36.6
OI-TS-5 Merritt	0.04	3.22	0.02	552	10.7	0.045	57.3	7.0	0.14	43.9

Butyltins, Total Polynuclear Aromatic Hydrocarbons (PAHs), PCBs and Pesticides
(ug/kg dry weight)

Sediment Treatment	PAHs Above Detection Limit			Butyltin Species			PCB	Chlorinated Pesticides	
	Molecular Weight		Total PAH	Tri-butyl	Di-butyl	Mono-butyl		Total DDD, DDE & DDT	Others
	Total Low	Total High							
OB-1(a)	0.6	0	0.6	0.6	0.4U	0.4U	2.3U	U _x	aBHC 0.3
OB-1(c)	1.2*	2.2*	3.3*	0.7	0.5U	0.4U	2.3U	U _x	aBHC 0.4
IB-2(a)	0.5	0	0.5	0.7	0.5U	0.5U	2.3U	U _x	aBHC 0.3, bBHC 0.2
IB-3(b)	1.9	2.8	4.6	0.8	0.5U	1.0+	2.3U	U _x	BHC _a = 0.3 b = 0.2 d = 0.2
CH-4	24	193	217	1.6U	1.5U	2.4U	4.0U	6.22	U _x
MS-1	2	18	20	1.1U	2.7U	5.1U	4.0U	4.0U	U _x
MS-1 Dup	3	13	16	—	—	—	4.0U	4.0U	Heptachlor 0.90
MS-2	6	69	75	3.2U	4.1U	4.4U	4.0U	0.99	U _x
OO-CH-1	32	169	201	0.84	0.46U	1.20U	4.0U	0.04U	U _x
OI-CH-4A	2	1	3	0.48U	0.27U	0.72U	4.0U	0.04U	U _x
OI-CH-6A	12	3	15	1.11U	0.62U	1.70U	4.0U	0.04U	U _x
OO-W-5	U _x	U _x	U _x	1.10U	0.59U	1.58U	4.0U	0.04U	U _x
OI-TS-5 Merritt	4	15	19	0.58U	0.32U	0.87U	4.0U	0.04U	U _x

Toxicity Tests

Sediment Treatment	Suspended Phase (LC50 as % of suspended)			Solid Phase (% mean survival)						
	Clam or Mussel Larvae	Young Fish	Shrimp	Clam		Worm		Amphipod		Young Fish
				10-day	28-day	10-day	28-day	Rhepoxinius	Ampelisca	
OB-1(a)\$	> 100	> 100	> 100	100	96.8	96.0	89.3	88.0	--	98.0
OB-1(c)	X	X	X	98.0	92.0	73.0	90	86.0	--	98.0
IB-2(a)	X	X	X	100	95.2	88.0	94.7	87.0	--	96.0
IB-3(b)	--	--	--	100	--	88.0	--	93.0	91.0	--
CH-4	--	--	--	99.0	--	92.0	--	89.0	85.0	--
MS-1	--	--	--	--	--	--	--	--	--	--
MS-1 Dup	--	--	--	--	--	--	--	--	--	--
MS-2	--	--	--	--	--	--	--	--	--	--
OO-CH-1	--	--	--	99.0	--	96.0	--	93.0	92.0	--
OI-CH-4A	--	--	--	100	--	58.0!	--	98.0	97.0	--
OI-CH-6A	--	--	--	100	--	83.0	--	97.0	98.0	--
OO-W-5	--	--	--	100	--	91.0	--	95.0	95.0	--
OI-TS-5 Merritt	--	--	--	--	--	--	--	--	--	--

U concentration is less than given detection limit

Ux concentration less than detection limit and detection limit varies by chemical.

- not analyzed

MS-1 consists of Merritt sands taken from cores TS-1, TS-3 & TS-4

* mean of replicate sample analyses

+ analyte contaminated and concentration not corrected for amount of contamination in analyte

X only 13% of the sediments in the composite used for this test came from this sample

! mortality due to laceration of soft tissue by ingestion of sharp-edged sand grains, not related to chemical contaminant

Battelle 1992, Berthing Areas report is the source of the OB-1, IB-2 and IB-3 data.

Battelle 1990, Phase I report is the source of the CH-4, MS-1 and MS-2 data.

Battelle 1990, Phase II report is the source of the OO-CH-1, OI-CH-4A, OI-CH-6A, OO-W-5 and OI-TS-5 Merritt data.

All samples were identified as 100% Older Bay Muds (OBM) by the geological description portions of the above reports. Merritt sands are the facies of OBMs deposited on dry land or along the shoreline.

\$ analyses were of a composite (of 3 samples) that was 94% Merritt Sand.

APPENDIX B

Air Quality Emission Tables

Table B-1. Emission Source Data for Ocean Section 102 Disposal

<i>Activity/ Equipment Type</i>	<i>HorsePower (Hp)</i>	<i>Load Factor</i>	<i>Number Active</i>	<i>Hp-Hours</i>	<i>Fuel Use Gal/Hr</i>	<i>Hours Per Day</i>	<i>Work Days</i>	<i>Total Fuel Usage</i>
Clamshell Sediments								
Tug Boat	2200	0.50	3	3300.0	217.8	22.5	675	3307838
Crew Boat	340	0.50	1	170.0	11.2	5.6	675	42412
Barge Equipment	95	0.50	4	190.0	12.5	22.5	675	190451
Pick-up Truck	NA	NA	1	NA	NA	5.6	675	NA

Table B-2. Emission Source Data for Alcatraz Disposal

<i>Activity/ Equipment Type</i>	<i>HorsePower (Hp)</i>	<i>Load Factor</i>	<i>Number Active</i>	<i>Hp-Hours</i>	<i>Fuel Use Gal/Hr</i>	<i>Hours Per Day</i>	<i>Work Days</i>	<i>Total Fuel Usage</i>
Clamshell Sediments								
Tug Boat	1200	0.50	1	600.0	39.6	22.5	1135.4	1011677
Crew Boat	340	0.50	1	170.0	11.2	5.6	1135.4	71342
Barge Equipment	95	0.50	1	47.5	3.1	22.5	1113.9	78569
Pick-up Truck	NA	NA	1	NA	NA	5.6	1135.4	NA

Table B-3. Emission Source Data for Bay Farm Disposal

<i>Activity/ Equipment Type</i>	<i>HorsePower (Hp)</i>	<i>Load Factor</i>	<i>Number Active</i>	<i>Hp-Hours</i>	<i>Fuel Use Gal/Hr</i>	<i>Hours Per Day</i>	<i>Work Days</i>	<i>Total Fuel Usage</i>
Hydraulic Sediments								
Tug Boat	1200	0.50	3	1800.0	118.8	22.5	145	387585
Crew Boat	340	0.50	1	170.0	11.2	5.6	130	8163
Barge Equipment	95	0.50	4	190.0	12.5	22.5	130	36657
Pick-up Truck	NA	NA	1	NA	NA	5.6	145	NA
Clamshell Sediments								
Tug Boat	1200	0.50	2	1200.0	79.2	22.5	592	1054231
Crew Boat	340	0.50	1	170.0	11.2	5.6	577	36224
Barge Equipment	95	0.50	3	142.5	9.4	22.5	577	121999
Pick-up Truck	NA	NA	1	NA	NA	5.6	592	NA

Table B-4. Emission Source Data for Montezuma Wetlands Disposal

<i>Activity/ Equipment Type</i>	<i>HorsePower (Hp)</i>	<i>Load Factor</i>	<i>Number Active</i>	<i>Hp-Hours</i>	<i>Fuel Use Gal/Hr</i>	<i>Hours Per Day</i>	<i>Work Days</i>	<i>Total Fuel Usage</i>
Hydraulic Sediments								
Tug Boat	1200	0.50	5	3000.0	198.0	22.5	408	1817640
Crew Boat	340	0.50	1	170.0	11.2	5.6	392	24655
Barge Equipment	95	0.50	6	285.0	18.8	22.5	392	166073
Pick-up Truck	NA	NA	1	NA	NA	5.6	408	NA
Clamshell Sediments								
Tug Boat	1200	0.50	2	1200.0	79.2	22.5	786	1400652
Crew Boat	340	0.50	1	170.0	11.2	5.6	770	48406
Barge Equipment	95	0.50	3	142.5	9.4	22.5	770	163026
Pick-up Truck	NA	NA	1	NA	NA	5.6	786	NA
Spoils Pump-out								
Hydraulic Dredge	3000	0.75	1	2250.0	148.5	5.6	259	215551
Tug Boat	400	0.50	1	200.0	13.2	22.5	259	76982
Generator	69	0.50	1	34.5	2.3	22.5	259	13279
Launch	75	0.50	1	37.5	2.5	22.5	244	13565

Table B-5. Duration of Activities for Alternative A1 - Maximum Ocean Disposal

<i>Activity/ Disposal Site</i>	<i>Days</i>
Harbor Dredging	823
Ocean Section 102	675
Galbraith GC	148

Table B-6. Duration of Activities for Alternative A2 - Maximum Ocean Disposal

<i>Disposal Site</i>	<i>Days</i>
Harbor Dredging	1467
Ocean Section 102	675
LeonardR/Redwood	331

Table B-7. Duration of Activities for Alternative B1 - Maximum Wetland Restoration

<i>Disposal Site</i>	<i>Days</i>
Harbor Dredging	1127
Ocean Section 102	13
Montezuma Wetlands	1105
Port/Landfill	12

Table B-8. Duration of Activities for Alternative B2 - Maximum Wetland Restoration

<i>Disposal Site</i>	<i>Days</i>
Harbor Dredging	933
Ocean Section 102	453
Sonoma Baylands	332
Galbraith GC	148

Table B-9. Duration of Activities for Alternative B3 - Maximum Wetland Restoration

<i>Disposal Site</i>	<i>Days</i>
Harbor Dredging	1321
Ocean Section 102	453
Sonoma Baylands	332
LeonardR/Redwood	331

Table B-10. Duration of Activities for Alternative C1 - All Upland Disposal

<i>Disposal Site</i>	<i>Days</i>
Harbor Dredging	1117
Montezuma Wetlands	1082
Galbraith GC	20

Table B-11. Duration of Activities for Alternative C2 - All Upland Disposal

<i>Disposal Site</i>	<i>Days</i>
Harbor Dredging	1126
Montezuma Wetland	1082
LeonardR/Redwood	27

Table B-12. Duration of Activities for Alternative D1 - Maximum Confined Aquatic Disposal

<i>Disposal Site</i>	<i>Days</i>
Harbor Dredging	702
Bay Farm Borrow	706

Table B-13. Duration of Activities for Alternative E1 - Maximum Unconfined Aquatic Disposal

<i>Disposal Site</i>	<i>Days</i>
Harbor Dredging	1355
Ocean Section 102	223
Alcatraz	1283
Galbraith GC	105

Table B-14. Duration of Activities for Alternative E2 - Maximum Unconfined Aquatic Disposal

<i>Disposal Site</i>	<i>Days</i>
Harbor Dredging	882
Ocean Section 102	223
Bay Farm Borrow	415
Galbraith GC	105

Table B-15. Duration of Activities for Alternative E3 - Maximum Unconfined Aquatic Disposal

<i>Disposal Site</i>	<i>Days</i>
Harbor Dredging	1659
Ocean Section 102	223
Alcatraz	1283
LeonardR/Redwood	331

Table B-16. Duration of Activities for Alternative E4 - Maximum Unconfined Aquatic Disposal

<i>Disposal Site</i>	<i>Days</i>
Harbor Dredging	1188
Ocean Section 102	223
Bay Farm Borrow	415
LeonardR/Redwood	331

Table B-17. Emission Factors for the Oakland Harbor Dredging and Disposal Project

<i>Equipment Type</i>	<i>Fuel Type</i>	<i>Emission Factors (Pounds/1000 Gallons)</i>							<i>Source</i>
		<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>	
Tug/Crew Boats	D	45.70	43.87	70.20	407.50	28.50	33.00	31.68	(a)
Barge Equipment	D	37.50	36.00	102.00	469.00	31.20	33.50	32.16	(b)
Hydraulic Dredge	D	37.50	36.00	102.00	469.00	31.20	33.50	32.16	(b)
Generator	D	37.50	36.00	102.00	469.00	31.20	33.50	32.16	(b)
Launch	G	1100.00	1056.00	3300.00	6.60	6.40	0.00	0.00	(c)
Pick-up Truck	G	0.20	0.19	2.30	0.24	0.02	0.03	0.03	(d)
Harbor Dredging	--	80.00	76.80	365.00	874.00	74.00	72.00	69.12	(e)

Notes: (a) ARB (1984), except SO2/PM from Scott Environmental Technology (1981).

(b) AP-42, Table 3.3-1, Vol. I (EPA, 1985).

(c) AP-42, Table II-4.1, Vol. II (EPA, 1985).

(d) EMFAC7PCD (ARB, 1988). Hourly emission rate based on 25 mph.

(e) Daily emissions provided by HLA.

(f) Pollutant abbreviations: total organic compounds (TOG), reactive organic compounds (ROG), carbon monoxide (CO), nitrogen oxides (NOx), sulfur dioxide (SO2), particulate matter (PM), particulate matter less than 10 microns in diameter (PM10)

Table B-18. Daily Emissions for Disposal at Ocean Section 102.

Activity/ Equipment Type	Pounds Per Day						
	TOG	ROG	CO	NOx	SO2	PM	PM10
Clamshell Sediments							
Tug Boat	224.0	215.0	344.0	1,997.0	139.7	161.7	155.2
Crew Boat	2.9	2.8	4.4	25.6	1.8	2.1	2.0
Barge Equipment	10.6	10.2	28.8	132.3	8.8	9.5	9.1
Pick-up Truck	1.0	1.0	11.5	1.2	0.1	0.2	0.2
Total Pounds/Day	238.4	228.9	388.7	2,156.1	150.4	173.4	166.5
Total Tons/Day	0.12	0.11	0.19	1.08	0.08	0.09	0.08
Pounds/Day - Mitigated	202.6	194.5	388.7	1,832.7	7.5	173.4	166.5
Tons/Day - Mitigated	0.10	0.10	0.19	0.92	0.00	0.09	0.08
Alameda/SF Cos. Tons/Day	381	188	790	164	26.5	266	141

Table B-19. Daily Emissions for Disposal at Alcatraz.

Activity/ Equipment Type	Pounds Per Day						
	TOG	ROG	CO	NOx	SO2	PM	PM10
Clamshell Sediments							
Tug Boat	40.7	39.1	62.5	363.1	25.4	29.4	28.2
Crew Boat	2.9	2.8	4.4	25.6	1.8	2.1	2.0
Barge Equipment	2.6	2.5	7.2	33.1	2.2	2.4	2.3
Pick-up Truck	1.0	1.0	11.5	1.2	0.1	0.2	0.2
Total Pounds/Day	47.2	45.3	85.7	423.0	29.5	34.0	32.6
Total Tons/Day	0.02	0.02	0.04	0.21	0.01	0.02	0.02
Pounds/Day - Mitigated	47.2	45.3	85.7	359.5	29.5	34.0	32.6
Tons/Day - Mitigated	0.02	0.02	0.04	0.18	0.00	0.02	0.02
Alameda/SF Cos. Tons/Day	381	188	790	164	26.5	266	141

Table B-20. Daily Emissions for Disposal at Bay Farm Borrow Area.

Activity/ Equipment Type	Pounds Per Day						
	TOG	ROG	CO	NOx	SO2	PM	PM10
Hydraulic Sediments							
Tug Boat	122.2	117.3	187.6	1,089.2	76.2	88.2	84.7
Crew Boat	2.9	2.8	4.4	25.6	1.8	2.1	2.0
Barge Equipment	10.6	10.2	28.8	132.3	8.8	9.5	9.1
Pick-up Truck	1.0	1.0	11.5	1.2	0.1	0.2	0.2
Clamshell Sediments							
Tug Boat	81.4	78.2	125.1	726.2	50.8	58.8	56.5
Crew Boat	2.9	2.8	4.4	25.6	1.8	2.1	2.0
Barge Equipment	7.9	7.6	21.6	99.2	6.6	7.1	6.8
Pick-up Truck	1.0	1.0	11.5	1.2	0.1	0.2	0.2
Total Pounds/Day	229.9	220.6	394.9	2,100.6	146.2	168.0	161.3
Total Tons/Day	0.11	0.11	0.20	1.05	0.07	0.08	0.08
Pounds/Day - Mitigated	195.4	187.5	394.9	1,785.5	7.3	168.0	161.3
Tons/Day - Mitigated	0.10	0.09	0.20	0.89	0.00	0.08	0.08
Alameda County Tons/Day	320	140	580	120	17	190	100

Table B-21. Daily Emissions for Disposal at Montezuma Wetlands.

<i>Activity/ Equipment Type</i>	<i>Pounds Per Day</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Hydraulic Sediments							
Tug Boat	203.6	195.4	312.7	1,815.4	127.0	147.0	141.1
Crew Boat	2.9	2.8	4.4	25.6	1.8	2.1	2.0
Barge Equipment	15.9	15.2	43.2	198.5	13.2	14.2	13.6
Pick-up Truck	1.0	1.0	11.5	1.2	0.1	0.2	0.2
Clamshell Sediments							
Tug Boat	81.4	78.2	125.1	726.2	50.8	58.8	56.5
Crew Boat	2.9	2.8	4.4	25.6	1.8	2.1	2.0
Barge Equipment	7.9	7.6	21.6	99.2	6.6	7.1	6.8
Pick-up Truck	1.0	1.0	11.5	1.2	0.1	0.2	0.2
Spoils Pump-out							
Hydraulic Dredge	31.2	29.9	84.8	390.0	25.9	27.9	26.7
Tug Boat	13.6	13.0	20.8	121.0	8.5	9.8	9.4
Generator	1.9	1.8	5.2	24.0	1.6	1.7	1.6
Launch	61.3	58.8	183.8	0.4	0.4	0.0	0.0
Spoils Handling							
Land-Based Equipment	18.2	17.5	154.3	225.6	22.7	18.8	18.0
Total Pounds/Day	442.7	425.0	983.4	3,654.0	260.4	289.7	278.1
Total Tons/Day	0.22	0.21	0.49	1.83	0.13	0.14	0.14
Pounds/Day - Mitigated	376.3	361.3	983.4	3,105.9	13.0	289.7	278.1
Tons/Day - Mitigated	0.19	0.18	0.49	1.55	0.01	0.14	0.14
Ala/CC/Sol Cos. Tons/Day	693	322	1153	307	84.4	356	243

Table B-22. Daily Emissions for Each Disposal Site - Unmitigated

<i>Disposal Site</i>	<i>Pounds Per Day</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Harbor Dredging	80.0	76.8	365.0	874.0	74.0	72.0	69.1
Ocean Section 102	238.4	228.9	388.7	2,156.1	150.4	173.4	166.5
Alcatraz	47.2	45.3	85.7	423.0	29.5	34.0	32.6
Bay Farm Borrow	229.9	220.6	394.9	2,100.6	146.2	168.0	161.3
LeonardR/RedwoodL	40.0	38.4	140.0	642.0	44.9	51.7	49.6
Sonoma Baylands	80.0	76.8	220.0	980.0	68.6	78.9	75.7
Galbraith GC	180.0	172.8	300.0	1,960.0	137.2	157.8	151.5
Port/Landfill	172.4	166.4	443.9	1,876.0	57.3	98.1	87.7
Montezuma Wetlands	442.7	425.0	983.4	3,654.0	260.4	289.7	278.1

Table B-23. Daily Emissions from Alternative A1 - Maximum Ocean Disposal

<i>Disposal Site</i>	<i>Pounds Per Day</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Harbor Dredging	80.0	76.8	365.0	874.0	74.0	72.0	69.1
Ocean Section 102	238.4	228.9	388.7	2,156.1	150.4	173.4	166.5
Galbraith GC	180.0	172.8	300.0	1,960.0	137.2	157.8	151.5
Total Pounds/Day	498.4	478.5	1,053.7	4,990.1	361.6	403.2	387.1
Total Tons/Day	0.25	0.24	0.53	2.50	0.18	0.20	0.19
Pounds/Day - Mitigated	423.6	406.7	1,053.7	4,241.6	18.1	403.2	387.1
Tons/Day - Mitigated	0.21	0.20	0.53	2.12	0.01	0.20	0.19
Counties Tons/Day	381	188	790	164	27	266	141

Table B-24. Daily Emissions from Alternative A2 - Maximum Ocean Disposal

<i>Disposal Site</i>	<i>Pounds Per Day</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Harbor Dredging	80.0	76.8	365.0	874.0	74.0	72.0	69.1
Ocean Section 102	238.4	228.9	388.7	2,156.1	150.4	173.4	166.5
LeonardR/RedwoodL	40.0	38.4	140.0	642.0	44.9	51.7	49.6
Total Pounds/Day	358.4	344.1	893.7	3,672.1	269.3	297.1	285.2
Total Tons/Day	0.18	0.17	0.45	1.84	0.13	0.15	0.14
Pounds/Day - Mitigated	304.6	292.4	893.7	3,121.3	13.5	297.1	285.2
Tons/Day - Mitigated	0.15	0.15	0.45	1.56	0.01	0.15	0.14
Counties Tons/Day	655	332	1093	214	32	431	228

Table B-25. Daily Emissions from Alternative B1 - Maximum Wetland Restoration

<i>Disposal Site</i>	<i>Pounds Per Day</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Harbor Dredging	80.0	76.8	365.0	874.0	74.0	72.0	69.1
Ocean Section 102	238.4	228.9	388.7	2,156.1	150.4	173.4	166.5
Montezuma Wetlands	442.7	425.0	983.4	3,654.0	260.4	289.7	278.1
Port/Landfill	172.4	166.4	443.9	1,876.0	57.3	98.1	87.7
Total Pounds/Day	933.5	897.1	2,181.0	8,560.1	542.1	633.2	601.4
Total Tons/Day	0.47	0.45	1.09	4.28	0.27	0.32	0.30
Pounds/Day - Mitigated	793.5	762.5	2,181.0	7,276.0	27.1	633.2	601.4
Tons/Day - Mitigated	0.40	0.38	1.09	3.64	0.01	0.32	0.30
Counties Tons/Day	754	370	1363	351	94	532	284

Table B-26. Daily Emissions from Alternative B2 - Maximum Wetland Restoration

<i>Disposal Site</i>	<i>Pounds Per Day</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Harbor Dredging	80.0	76.8	365.0	874.0	74.0	72.0	69.1
Ocean Section 102	238.4	228.9	388.7	2,156.1	150.4	173.4	166.5
Sonoma Baylands	80.0	76.8	220.0	980.0	68.6	78.9	75.7
Galbraith GC	180.0	172.8	300.0	1,960.0	137.2	157.8	151.5
Total Pounds/Day	578.4	555.3	1,273.7	5,970.1	430.2	482.1	462.8
Total Tons/Day	0.29	0.28	0.64	2.99	0.22	0.24	0.23
Pounds/Day - Mitigated	491.6	472.0	1,273.7	5,074.6	21.5	482.1	462.8
Tons/Day - Mitigated	0.25	0.24	0.64	2.54	0.01	0.24	0.23
Counties Tons/Day	580	295	973	195	30	373	198

Table B-27. Daily Emissions from Alternative B3 - Maximum Wetland Restoration

<i>Disposal Site</i>	<i>Pounds Per Day</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Harbor Dredging	80.0	76.8	365.0	874.0	74.0	72.0	69.1
Ocean Section 102	238.4	228.9	388.7	2,156.1	150.4	173.4	166.5
Sonoma Baylands	80.0	76.8	220.0	980.0	68.6	78.9	75.7
LeonardR/RedwoodL	40.0	38.4	140.0	642.0	44.9	51.7	49.6
Total Pounds/Day	438.4	420.9	1,113.7	4,652.1	337.9	376.0	360.9
Total Tons/Day	0.22	0.21	0.56	2.33	0.17	0.19	0.18
Pounds/Day - Mitigated	372.6	357.7	1,113.7	3,954.3	16.9	376.0	360.9
Tons/Day - Mitigated	0.19	0.18	0.56	1.98	0.01	0.19	0.18
Counties Tons/Day	854	404	1273	310	70	515	273

Table B-28. Daily Emissions from Alternative C1 - All Upland Disposal

<i>Disposal Site</i>	<i>Pounds Per Day</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Harbor Dredging	80.0	76.8	365.0	874.0	74.0	72.0	69.1
Montezuma Wetlands	442.7	425.0	983.4	3,654.0	260.4	289.7	278.1
Galbraith GC	180.0	172.8	300.0	1,960.0	137.2	157.8	151.5
Total Pounds/Day	702.7	674.6	1,648.4	6,488.0	471.6	519.4	498.7
Total Tons/Day	0.35	0.34	0.82	3.24	0.24	0.26	0.25
Pounds/Day - Mitigated	597.3	573.4	1,648.4	5,514.8	23.6	519.4	498.7
Tons/Day - Mitigated	0.30	0.29	0.82	2.76	0.01	0.26	0.25
Counties Tons/Day	693	322	1153	307	84	456	243

Table B-29. Daily Emissions from Alternative C2 - All Upland Disposal

<i>Disposal Site</i>	<i>Pounds Per Day</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Harbor Dredging	80.0	76.8	365.0	874.0	74.0	72.0	69.1
Montezuma Wetlands	442.7	425.0	983.4	3,654.0	260.4	289.7	278.1
LeonardR/RedwoodL	40.0	38.4	140.0	642.0	44.9	51.7	49.6
Total Pounds/Day	562.7	540.2	1,488.4	5,170.0	379.3	413.3	396.8
Total Tons/Day	0.28	0.27	0.74	2.58	0.19	0.21	0.20
Pounds/Day - Mitigated	478.3	459.2	1,488.4	4,394.5	19.0	413.3	396.8
Tons/Day - Mitigated	0.24	0.23	0.74	2.20	0.01	0.21	0.20
Counties Tons/Day	967	466	1456	357	89	621	330

Table B-30. Daily Emissions from Alternative D1 - Maximum Confined Aquatic Disposal

<i>Disposal Site</i>	<i>Pounds Per Day</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Harbor Dredging	80.0	76.8	365.0	874.0	74.0	72.0	69.1
Bay Farm Borrow	229.9	220.6	394.9	2,100.6	146.2	168.0	161.3
Total Pounds/Day	309.9	297.4	759.9	2,974.6	220.2	240.0	230.4
Total Tons/Day	0.15	0.15	0.38	1.49	0.11	0.12	0.12
Pounds/Day - Mitigated	263.4	252.8	759.9	2,528.4	11.0	240.0	230.4
Tons/Day - Mitigated	0.13	0.13	0.38	1.26	0.01	0.12	0.12
County Tons/Day	320	140	580	120	17	190	100

Table B-31. Daily Emissions from Alternative E1 - Maximum Unconfined Aquatic Disposal

<i>Disposal Site</i>	<i>Pounds Per Day</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Harbor Dredging	80.0	76.8	365.0	874.0	74.0	72.0	69.1
Ocean Section 102	238.4	228.9	388.7	2,156.1	150.4	173.4	166.5
Alcatraz	47.2	45.3	85.7	423.0	29.5	34.0	32.6
Galbraith GC	180.0	172.8	300.0	1,960.0	137.2	157.8	151.5
Total Pounds/Day	545.6	523.8	1,139.4	5,413.1	391.0	437.2	419.7
Total Tons/Day	0.27	0.26	0.57	2.71	0.20	0.22	0.21
Pounds/Day - Mitigated	463.8	445.2	1,139.4	4,601.1	19.6	437.2	419.7
Tons/Day - Mitigated	0.23	0.22	0.57	2.30	0.01	0.22	0.21
Counties Tons/Day	381	188	790	164	27	266	141

Table B-32. Daily Emissions from Alternative E2 - Maximum Unconfined Aquatic Disposal

<i>Disposal Site</i>	<i>Pounds Per Day</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Harbor Dredging	80.0	76.8	365.0	874.0	74.0	72.0	69.1
Ocean Section 102	238.4	228.9	388.7	2,156.1	150.4	173.4	166.5
Bay Farm Borrow	229.9	220.6	394.9	2,100.6	146.2	168.0	161.3
Galbraith GC	180.0	172.8	300.0	1,960.0	137.2	157.8	151.5
Total Pounds/Day	728.3	699.1	1,448.6	7,090.7	507.7	571.2	548.3
Total Tons/Day	0.36	0.35	0.72	3.55	0.25	0.29	0.27
Pounds/Day - Mitigated	619.0	594.2	1,448.6	6,027.1	25.4	571.2	548.3
Tons/Day - Mitigated	0.31	0.30	0.72	3.01	0.01	0.29	0.27
Counties Tons/Day	381	188	790	164	27	266	141

Table B-33. Daily Emissions from Alternative E3 - Maximum Unconfined Aquatic Disposal

<i>Disposal Site</i>	<i>Pounds Per Day</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Harbor Dredging	80.0	76.8	365.0	874.0	74.0	72.0	69.1
Ocean Section 102	238.4	228.9	388.7	2,156.1	150.4	173.4	166.5
Alcatraz	47.2	45.3	85.7	423.0	29.5	34.0	32.6
LeonardR/RedwoodL	40.0	38.4	140.0	642.0	44.9	51.7	49.6
Total Pounds/Day	405.6	389.4	979.4	4,095.1	298.8	331.1	317.8
Total Tons/Day	0.20	0.19	0.49	2.05	0.15	0.17	0.16
Pounds/Day - Mitigated	344.8	331.0	979.4	3,480.8	14.9	331.1	317.8
Tons/Day - Mitigated	0.17	0.17	0.49	1.74	0.01	0.17	0.16
Counties Tons/Day	655	332	1093	214	32	431	228

Table B-34. Daily Emissions from Alternative E4 - Maximum Unconfined Aquatic Disposal

<i>Disposal Site</i>	<i>Pounds Per Day</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Harbor Dredging	80.0	76.8	365.0	874.0	74.0	72.0	69.1
Ocean Section 102	238.4	228.9	388.7	2,156.1	150.4	173.4	166.5
Bay Farm Borrow	229.9	220.6	394.9	2,100.6	146.2	168.0	161.3
LeonardR/RedwoodL	40.0	38.4	140.0	642.0	44.9	51.7	49.6
Total Pounds/Day	588.3	564.7	1,288.6	5,772.7	415.5	465.1	446.5
Total Tons/Day	0.29	0.28	0.64	2.89	0.21	0.23	0.22
Pounds/Day - Mitigated	500.0	480.0	1,288.6	4,906.8	20.8	465.1	446.5
Tons/Day - Mitigated	0.25	0.24	0.64	2.45	0.01	0.23	0.22
Counties Tons/Day	655	332	1093	214	32	431	228

Table B-35. Total Emissions for Disposal at Ocean Section 102.

<i>Activity/ Equipment Type</i>	<i>Total Tons</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Clamshell Sediments							
Tug Boat	75.6	72.6	116.1	674.0	47.1	54.6	52.4
Crew Boat	1.0	0.9	1.5	8.6	0.6	0.7	0.7
Barge Equipment	3.6	3.4	9.7	44.7	3.0	3.2	3.1
Pick-up Truck	0.3	0.3	3.9	0.4	0.0	0.1	0.1
Total	80.5	77.2	131.2	727.7	50.7	58.5	56.2
Mitigated Emissions	68.4	65.7	131.2	618.5	2.5	58.5	56.2

Table B-36. Total Emissions for Disposal at Alcatraz.

<i>Activity/ Equipment Type</i>	<i>Total Tons</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Clamshell Sediments							
Tug Boat	23.1	22.2	35.5	206.1	14.4	16.7	16.0
Crew Boat	1.6	1.6	2.5	14.5	1.0	1.2	1.1
Barge Equipment	1.5	1.4	4.0	18.4	1.2	1.3	1.3
Pick-up Truck	0.6	0.5	6.5	0.7	0.1	0.1	0.1
Total	26.8	25.7	48.5	239.8	16.7	19.3	18.5
Mitigated Emissions	26.8	25.7	48.5	203.8	16.7	19.3	18.5

Table B-37. Total Emissions for Disposal at Bay Farm Borrow Area.

<i>Activity/ Equipment Type</i>	<i>Total Tons</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Hydraulic Sediments							
Tug Boat	8.9	8.5	13.6	79.0	5.5	6.4	6.1
Crew Boat	0.2	0.2	0.3	1.7	0.1	0.1	0.1
Barge Equipment	0.7	0.7	1.9	8.6	0.6	0.6	0.6
Pick-up Truck	0.1	0.1	0.8	0.1	0.0	0.0	0.0
Clamshell Sediments							
Tug Boat	24.1	23.1	37.0	214.8	15.0	17.4	16.7
Crew Boat	0.8	0.8	1.3	7.4	0.5	0.6	0.6
Barge Equipment	2.3	2.2	6.2	28.6	1.9	2.0	2.0
Pick-up Truck	0.3	0.3	3.4	0.4	0.0	0.0	0.0
Total	37.3	35.8	64.5	340.5	23.7	27.2	26.1
Mitigated Emissions	31.7	30.4	64.5	289.4	1.2	27.2	26.1

Table B-38. Total Emissions for Disposal at Montezuma Wetlands.

<i>Activity/ Equipment Type</i>	<i>Total Tons</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Hydraulic Sediments							
Tug Boat	41.5	39.9	63.8	370.3	25.9	30.0	28.8
Crew Boat	0.6	0.5	0.9	5.0	0.4	0.4	0.4
Barge Equipment	3.1	3.0	8.5	38.9	2.6	2.8	2.7
Pick-up Truck	0.2	0.2	2.3	0.2	0.0	0.0	0.0
Clamshell Sediments							
Tug Boat	32.0	30.7	49.2	285.4	20.0	23.1	22.2
Crew Boat	1.1	1.1	1.7	9.9	0.7	0.8	0.8
Barge Equipment	3.1	2.9	8.3	38.2	2.5	2.7	2.6
Pick-up Truck	0.4	0.4	4.5	0.5	0.0	0.1	0.1
Spoils Pump-out							
Hydraulic Dredge	4.0	3.9	11.0	50.5	3.4	3.6	3.5
Tug Boat	1.8	1.7	2.7	15.7	1.1	1.3	1.2
Generator	0.2	0.2	0.7	3.1	0.2	0.2	0.2
Launch	7.5	7.2	22.4	0.0	0.0	0.0	0.0
Spoils Pump-out							
Land-based Equipment	6.0	5.7	50.5	73.9	7.4	6.1	5.9
Total	101.5	97.4	226.5	891.8	64.2	71.2	68.3
Mitigated Emissions	86.2	82.8	226.5	758.0	3.2	71.2	68.3

Table B-39. Total Emissions from Alternative A1 - Maximum Ocean Disposal

<i>Disposal Site</i>	<i>Total Tons</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Harbor Dredging	40.8	39.2	186.3	446.2	37.8	36.8	35.3
Ocean Section 102	106.2	102.0	173.2	960.5	67.0	77.2	74.2
Galbraith GC	11.1	10.6	18.5	120.5	8.4	9.7	9.3
Total	158.1	151.8	378.0	1,527.3	113.2	123.7	118.8
Mitigated Emissions	134.4	129.0	378.0	1,298.2	5.7	123.7	118.8

Table B-40. Total Emissions from Alternative A2 - Maximum Ocean Disposal

<i>Disposal Site</i>	<i>Total Tons</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Harbor Dredging	51.5	49.4	234.9	562.4	47.6	46.3	44.5
Ocean Section 102	106.2	102.0	173.2	960.5	67.0	77.2	74.2
LeonardR/RedwoodL	7.8	7.5	27.2	124.9	8.7	10.1	9.6
Total	165.5	158.8	435.3	1,647.8	123.3	133.6	128.3
Mitigated Emissions	140.6	135.0	435.3	1,400.7	6.2	133.6	128.3

Table B-41. Total Emissions from Alternative B1 - Maximum Wetland Restoration

<i>Disposal Site</i>	<i>Total Tons</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Harbor Dredging	39.6	38.0	180.5	432.2	36.6	35.6	34.2
Ocean Section 102	1.5	1.5	2.5	14.0	1.0	1.1	1.1
Montezuma Wetlands	214.5	205.9	476.4	1770.3	126.2	140.3	134.7
Port/Landfill	1.0	1.0	2.7	11.3	0.3	0.6	0.5
Total	256.7	246.4	662.1	2,227.8	164.1	177.7	170.5
Mitigated Emissions	218.2	209.4	662.1	1,893.6	8.2	177.7	170.5

Table B-42. Total Emissions from Alternative B2 - Maximum Wetland Restoration

<i>Disposal Site</i>	<i>Total Tons</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Harbor Dredging	35.7	34.3	163.0	390.2	33.0	32.1	30.9
Ocean Section 102	41.0	39.4	66.9	370.8	25.9	29.8	28.6
Sonoma Baylands	16.8	16.1	46.1	205.3	14.4	16.5	15.9
Galbraith GC	11.1	10.6	18.5	120.5	8.4	9.7	9.3
Total	104.6	100.4	294.4	1,086.9	81.7	88.2	84.7
Mitigated Emissions	88.9	85.3	294.4	923.9	4.1	88.2	84.7

Table B-43. Total Emissions from Alternative B3 - Maximum Wetland Restoration

<i>Disposal Site</i>	<i>Total Tons</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Harbor Dredging	46.4	44.5	211.5	506.5	42.9	41.7	40.1
Ocean Section 102	41.0	39.4	66.9	370.8	25.9	29.8	28.6
Sonoma Baylands	16.8	16.1	46.1	205.3	14.4	16.5	15.9
LeonardR/RedwoodL	7.8	7.5	27.2	124.9	8.7	10.1	9.6
Total	111.9	107.4	351.7	1,207.5	91.9	98.1	94.2
Mitigated Emissions	95.1	91.3	351.7	1,026.4	4.6	98.1	94.2

Table B-44. Total Emissions from Alternative C1 - All Upland Disposal

<i>Disposal Site</i>	<i>Total Tons</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Harbor Dredging	35.2	33.8	160.6	384.6	32.6	31.7	30.4
Montezuma Wetlands	210.1	201.7	466.6	1733.8	123.6	137.4	132.0
Galbraith GC	2.2	2.1	3.6	23.5	1.6	1.9	1.8
Total	247.4	237.5	630.8	2,141.9	157.8	171.0	164.2
Mitigated Emissions	210.3	201.9	630.8	1,820.6	7.9	171.0	164.2

Table B-45. Total Emissions from Alternative C2 - All Upland Disposal

<i>Disposal Site</i>	<i>Total Tons</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Harbor Dredging	39.5	37.9	180.3	431.8	36.6	35.6	34.1
Montezuma Wetlands	210.1	201.7	466.6	1733.8	123.6	137.4	132.0
LeonardR/RedwoodL	0.6	0.6	2.1	9.6	0.7	0.8	0.7
Total	250.2	240.2	649.0	2,175.2	160.8	173.8	166.8
Mitigated Emissions	212.7	204.2	649.0	1,848.9	8.0	173.8	166.8

Table B-46. Total Emissions from Alternative D1 - Maximum Confined Aquatic Disposal

<i>Disposal Site</i>	<i>Total Tons</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Harbor Dredging	24.6	23.7	112.4	269.2	22.8	22.2	21.3
Bay Farm Borrow	70.0	67.2	120.3	639.6	44.5	51.2	49.1
Total	94.6	90.8	232.7	908.8	67.3	73.3	70.4
Mitigated Emissions	80.4	77.2	232.7	772.5	3.4	73.3	70.4

Table B-47. Total Emissions from Alternative E1 - Maximum Unconfined Aquatic Disposal

<i>Disposal Site</i>	<i>Total Tons</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Harbor Dredging	47.6	45.7	217.0	519.6	44.0	42.8	41.1
Ocean Section 102	34.1	32.7	55.6	308.3	21.5	24.8	23.8
Alcatraz	18.3	17.5	33.1	163.5	11.4	13.1	12.6
Galbraith GC	11.1	10.6	18.5	120.5	8.4	9.7	9.3
Total	111.0	106.5	324.1	1,111.9	85.3	90.4	86.8
Mitigated Emissions	94.3	90.6	324.1	945.1	4.3	90.4	86.8

Table B-48. Total Emissions from Alternative E2 - Maximum Unconfined Aquatic Disposal

<i>Disposal Site</i>	<i>Total Tons</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Harbor Dredging	31.0	29.7	141.3	338.2	28.6	27.9	26.7
Ocean Section 102	34.1	32.7	55.6	308.3	21.5	24.8	23.8
Bay Farm Borrow	41.1	39.5	70.7	376.0	26.2	30.1	28.9
Galbraith GC	11.1	10.6	18.5	120.5	8.4	9.7	9.3
Total	117.3	112.6	286.0	1,143.1	84.7	92.4	88.7
Mitigated Emissions	99.7	95.7	286.0	971.6	4.2	92.4	88.7

Table B-49. Total Emissions from Alternative E3 - Maximum Unconfined Aquatic Disposal

<i>Disposal Site</i>	<i>Total Tons</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Harbor Dredging	57.8	55.5	263.7	631.5	53.5	52.0	49.9
Ocean Section 102	34.1	32.7	55.6	308.3	21.5	24.8	23.8
Alcatraz	18.3	17.5	33.1	163.5	11.4	13.1	12.6
LeonardR/RedwoodL	7.8	7.5	27.2	124.9	8.7	10.1	9.6
Total	117.9	113.2	379.6	1,228.1	95.1	100.0	96.0
Mitigated Emissions	100.2	96.2	379.6	1,043.9	4.8	100.0	96.0

Table B-50. Total Emissions from Alternative E4 - Maximum Unconfined Aquatic Disposal

<i>Disposal Site</i>	<i>Pounds Per Day</i>						
	<i>TOG</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>SO2</i>	<i>PM</i>	<i>PM10</i>
Harbor Dredging	41.6	39.9	189.8	454.5	38.5	37.4	35.9
Ocean Section 102	34.1	32.7	55.6	308.3	21.5	24.8	23.8
Bay Farm Borrow	41.1	39.5	70.7	376.0	26.2	30.1	28.9
LeonardR/RedwoodL	7.8	7.5	27.2	124.9	8.7	10.1	9.6
Total	124.6	119.6	343.3	1,263.7	94.9	102.4	98.3
Mitigated Emissions	105.9	101.7	343.3	1,074.1	4.7	102.4	98.3

APPENDIX C

Biological Resources

**Table C-1. Special-Status Plant and Animal Taxa Occurring or Potentially Occurring,
Sonoma Baylands Disposal Alternative and Leonard Ranch/Redwood Landfill Disposal Alternative Sites,
Sonoma County, California**
(Page 1 of 6)

<i>Common Name</i>	<i>Scientific Name</i>	<i>Status (a)</i>	<i>Habitat (b)</i>	<i>Reported Localities in Project Area (c)</i>	<i>Potential for Occurrence</i>
PLANTS					
Sonoma alopecurus	<i>Alopecurus aequalis</i> var. <i>sonomensis</i>	C2, 1B	Freshwater marsh, riparian scrub	Northwest of Cotati, Sonoma County	Not expected: No suitable habitat present.
Suisun marsh aster	<i>Aster lentus</i>	C2, 1B	Brackish marsh, coastal salt marsh	Fagan Slough, Napa County	Not expected: Was not detected.
Baker's blennosperma	<i>Blennosperma bakeri</i>	FE, SE, 1B	Vernal pools, valley grassland	Western outskirts of Sonoma in low marshy pasture	Low: Marginally suitable habitat onsite; would not have been detected during survey.
Tiburon Indian paintbrush	<i>Castilleja affinis</i> ssp. <i>neglecta</i>	PE, ST, 1B	Open serpentine slopes; <300m	Tiburon, Marin County	Not expected: No suitable habitat present.
Suisun thistle	<i>Cirsium hydrophilum</i> var. <i>hydrophilum</i>	C1, 1B	Salt marsh; +/- 0m	Suisun Marsh, Solano County	Low: Outside known range.
salt marsh bird's- beak	<i>Cordylanthus maritimus</i> ssp. <i>maritimus</i>	FE, SE, 1B	Coastal salt marsh	Not recorded in the project vicinity	Low: Was not detected.
Point Reyes bird's- beak	<i>Cordylanthus maritimus</i> ssp. <i>palustris</i>	C2, 1B	Coastal salt marsh and swamps	Bucks Landing, Gallinas Creek, Marin County	Not expected: Was not detected.
soft bird's-beak	<i>Cordylanthus mollis</i> ssp. <i>mollis</i>	C1, SR, 1B	Coastal salt marsh	Petaluma Marsh, Sonoma County	Low: Would have been detectable during survey.
Baker's larkspur	<i>Delphinium luteum</i>	C1, SR, 1B	Coastal scrub	Two miles west of Petaluma, Sonoma County	Not expected: No suitable habitat present.
dwarf downingia	<i>Downingia pusilla</i>	C3c, 2	Mesic grassland, vernal pool	Three miles north of Agua Caliente, Sonoma County	Low: Marginally suitable habitat onsite; would not have been detected during survey.
fragrant fritillary	<i>Fritillaria liliacea</i>	C2, 1B	Coastal scrub, valley grassland	Nicasio Reservoir, Marin County	Not expected: No suitable habitat onsite.
Diablo rock-rose	<i>Helianthella castanea</i>	C2, 1B	Open grassy sites; 200 - 1,300m	Oakland, Alameda County	Not expected: Outside known elevation range.

**Table C-1. Special-Status Plant and Animal Taxa Occurring or Potentially Occurring,
Sonoma Baylands Disposal Alternative and Leonard Ranch/Redwood Landfill Disposal Alternative Sites,
Sonoma County, California**
(Page 2 of 6)

<i>Common Name</i>	<i>Scientific Name</i>	<i>Status (a)</i>	<i>Habitat (b)</i>	<i>Reported Localities in Project Area (c)</i>	<i>Potential for Occurrence</i>
Marin dwarf-flax	<i>Hesperolinon congestum</i>	PT, ST, 1B	Serpentine, grassland < 200m	Tiburon, Marin County	Not expected: No suitable habitat present.
Contra Costa goldfields	<i>Lasthenia conjugens</i>	C1, 1B	Vernal pools, valley grassland	Suscol Creek along Highways 12 and 29, Napa County	Low: Marginally suitable habitat onsite; would not have been detected during survey.
delta tule pea	<i>Lathyrus jepsonii</i> ssp. <i>jepsonii</i>	C2, 1B	Brackish marsh	Fagan Slough, Fagan Marsh, Napa County	Low: Marginally suitable habitat onsite; was not detected.
legenere	<i>Legenere limosa</i>	C2, 1B	Vernal pools	Sonoma Mountains, Sonoma County	Low: Marginally suitable habitat onsite; would not have been detected during survey.
Mason's lilaeopsis	<i>Lilaeopsis masonii</i>	C2, SR, 1B	Intertidal brackish marsh	Napa River, Napa County	Not expected: No suitable habitat present.
Sebastopol meadowfoam	<i>Limnanthes vinculans</i>	FE, SE, 1B	Mesic meadows, vernal pools	South of Santa Rosa, Sonoma County	Low: Marginally suitable habitat onsite; would not have been detected during survey.
Petaluma popcorn flower	<i>Plagiobothrys mollis</i> var. <i>vertitus</i>	C2, 1A	Valley grassland	Vicinity of Petaluma, Sonoma County	Low: Was not detected.
Northcoast semaphore grass	<i>Pleuropogon hooverianus</i>	C2, SR, 1B	Marshy areas, Redwood groves; <500m	Mt. Tamalpais, Marin County; Sebastopol, Cotati, Glen Ellen, Sonoma County	Not expected: No suitable habitat present.
Marin knotweed	<i>Polygonum marinense</i>	C2, 3	Coastal salt marsh	Along the Petaluma River, Sonoma, Marin counties	Moderate: Suitable habitat in project vicinity; was not detected.
Showy indian clover	<i>Trifolium amoenum</i>	C2, 1B	Valley grassland	Two miles south of Petaluma, Sonoma County	Not expected: No suitable habitat present.
AMPHIBIANS/REPTILES					
California tiger salamander	<i>Ambystoma californiense</i>	C1, CSC	Vernal pools, ponds, near burrows	Jepson Prairie, Solano County	Not expected: No suitable habitat present.

**Table C-1. Special-Status Plant and Animal Taxa Occurring or Potentially Occurring,
Sonoma Baylands Disposal Alternative and Leonard Ranch/Redwood Landfill Disposal Alternative Sites,
Sonoma County, California**
(Page 3 of 6)

<i>Common Name</i>	<i>Scientific Name</i>	<i>Status (a)</i>	<i>Habitat (b)</i>	<i>Reported Localities in Project Area (c)</i>	<i>Potential for Occurrence</i>
northwestern pond turtle	<i>Clemmys marmorata marmorata</i>	C2, CSC	Permanent or nearly permanent water	Stemple Creek, Marin County	Not expected: No suitable habitat present.
California red-legged frog	<i>Rana aurora draytoni</i>	C1, CSC	Ponds, slow moving freshwater	Lands End, Lincoln Park, San Francisco	Not expected: Suitable aquatic habitats absent.
foothill yellow-legged frog	<i>Rana boylei</i>	C2, CSC	Rocky streams	Marin and Sonoma counties	Not expected: No suitable habitat present.
western spadefoot toad	<i>Scaphiopus hammondi hammondi</i>	CSC	Grasslands with temporary pools	Sonoma County	Not expected: No suitable habitat present.
MAMMALS					
Point Reyes mountain beaver	<i>Aplodontia rufa phaea</i>	C2, CSC	Hillsides in seepage areas overgrown with sword ferns and thimbleberries of Point Reyes area	Point Reyes area, west of Inverness, Marin County	Not expected: Site not within range of subspecies.
California western mastiff bat	<i>Eumops perotis californicus</i>	C2, CSC	Open habitats, cliffs, tunnels, trees	Lake County	Not expected: No suitable habitat present.
San Pablo vole	<i>Microtus californicus sanpabloensis</i>	C2, CSC	Salt marshes of San Pablo Creek	Giant Salt Marsh, Contra Costa County	Not expected: Outside reported range.
San Francisco dusky-footed woodrat	<i>Neotoma fuscipes annectens</i>	C2, CSC	Forests and chaparral	San Francisco, San Mateo, and Santa Cruz counties	Not expected: Site not within range of subspecies. No habitat present.
San Joaquin Valley woodrat	<i>Neotoma fuscipes riparia</i>	C1, CSC	Riparian areas of trees and brush along the San Joaquin, Stanislaus and Tuolumne rivers	San Joaquin County	Not expected: Site not within range of subspecies.
Townsend's western big-eared bat	<i>Plecotus townsendii townsendii</i>	C2, CSC	Humid coastal regions of California	Marin County	Not expected: No suitable roosting habitat available.
salt marsh harvest mouse	<i>Reithrodontomys raviventris halicoetes</i>	FE, SE	Salt marshes	Petalum Marsh, Marin County	Not expected: Would have been observed during surveys.

**Table C-1. Special-Status Plant and Animal Taxa Occurring or Potentially Occurring,
Sonoma Baylands Disposal Alternative and Leonard Ranch/Redwood Landfill Disposal Alternative Sites,
Sonoma County, California**
(Page 4 of 6)

<i>Common Name</i>	<i>Scientific Name</i>	<i>Status (a)</i>	<i>Habitat (b)</i>	<i>Reported Localities in Project Area (c)</i>	<i>Potential for Occurrence</i>
Suisun ornate shrew	<i>Sorex ornatus sinuosus</i>	C1, CSC	Tidal marshes with low-lying dense cover	Sears Point, Sonoma County	Not expected: Would have been observed during surveys.
salt marsh wandering shrew	<i>Sorex vagrans halicoetes</i>	C1, CSC	Salt marshes	San Pablo Creek Salt Marsh, north of Richmond	Not expected: Would have been observed during surveys.
Point Reyes jumping mouse	<i>Zapus trinotatus orarius</i>	C2, CSC	Bunchgrass marshes on the uplands of Point Reyes	Point Reyes, Marin County	Not expected: Site not within range of subspecies, no habitat present.
BIRDS					
tricolored blackbird	<i>Agelaius tricolor</i>	C2, CSC	Marshes with cattails and tules	Napa/Sonoma Marsh Wildlife Area, south of Napa	Moderate: Suitable foraging habitat present.
burrowing owl	<i>Athene cunicularia</i>	CSC	Open nearly level ground; mammal burrows	Upper Tubbs Island, Sonoma County	Moderate: Was not detected during survey. May forage in agricultural field and nest in perimeter levees.
short-eared owl	<i>Asio flammeus</i>	CSC	Tule patches/tall grass, lowland meadows	Wildcat Creek Marsh, Contra Costa County	Not expected: Sites not suitable for nesting.
Western snowy plover	<i>Charadrius alexandrinus nivosus</i>	FT, CSC	Friable soil for nesting	Little Island evaporator, Napa/Sonoma counties	Not expected: No suitable habitat present.
northern harrier	<i>Circus cyaneus</i>	CSC	Grasslands, marsh	Along Highway 37 between Sears Point and Vallejo	Observed on both sites.
Peregrine falcon	<i>Falco peregrinus anatum</i>	SE, FE	Ledges on high cliffs near water; forages in open areas	Statewide migrant	Low: Site not suitable for nesting; may forage onsite during migration.
salt marsh yellowthroat	<i>Geothlypis trichas sinuosa</i>	C2, CSC	Freshwater and brackish marsh, woody swamps	Petaluma Marsh, Sonoma County	High: Expected to forage in salt marsh along San Pablo Bay.

**Table C-1. Special-Status Plant and Animal Taxa Occurring or Potentially Occurring,
Sonoma Baylands Disposal Alternative and Leonard Ranch/Redwood Landfill Disposal Alternative Sites,
Sonoma County, California**
(Page 5 of 6)

<i>Common Name</i>	<i>Scientific Name</i>	<i>Status (a)</i>	<i>Habitat (b)</i>	<i>Reported Localities in Project Area (c)</i>	<i>Potential for Occurrence</i>
California black rail	<i>Laterallus jamaicensis coturniculus</i>	C2, ST	Coastal salt marsh, dense/tall pickelweed	Midshipman's Point, Tubbs Island, San Pablo Bay	High: Expected to forage in salt marsh along San Pablo Bay.
San Pablo song sparrow	<i>Melospiza melodia samuelis</i>	C2, CSC	Salt and brackish tidal marshes	San Francisco Bay Area	High: Expected to forage in salt marsh along San Pablo Bay.
California clapper rail	<i>Rallus longirostris obsoletus</i>	FE, SE, CP	Coastal salt marsh, tidal marsh	Black Point, mouth of Petaluma River	High: Expected to forage in salt marsh along San Pablo Bay.
northern spotted owl	<i>Strix occidentalis caurina</i>	FT	Dense, old- growth forest	Marin County	Not expected: No suitable habitat present.
FISH					
green sturgeon	<i>Acipenser medirostris</i>	2R	Estuaries, lower reaches of larger rivers, salt or brackish water off river mouths	San Francisco Bay, San Pablo Bay	Not expected: No suitable habitat present.
tidewater goby	<i>Eucyclogobius newberryi</i>	FE, CSC	Fresh/brackish water	Novato Creek, Marin County	Not expected: Sites hydrologically isolated from bay.
winter-run chinook salmon	<i>Oncorhynchus tshawytscha</i>	SE, FT	Spawn in rivers with gravels	San Pablo Bay	Not expected: No suitable habitat present.
Sacramento splittail	<i>Pogonichthys macrolepidotus</i>	PT	Backwaters and pools of rivers, tolerant of brackish water	Sacramento, San Joaquin Delta, Napa Marsh	Not expected: No suitable habitat present.
longfin smelt	<i>Spirinchus thaleichthys</i>	C2	Near shore; bays and estuaries	San Francisco Bay, San Pablo Bay	Not expected: No suitable habitat present.

**Table C-1. Special-Status Plant and Animal Taxa Occurring or Potentially Occurring,
Sonoma Baylands Disposal Alternative and Leonard Ranch/Redwood Landfill Disposal Alternative Sites,
Sonoma County, California**
(Page 6 of 6)

<i>Common Name</i>	<i>Scientific Name</i>	<i>Status (a)</i>	<i>Habitat (b)</i>	<i>Reported Localities in Project Area (c)</i>	<i>Potential for Occurrence</i>
INVERTEBRATES					
Bridge's band snail	<i>Helminthoglypta nickliniana bridgesi</i>	C2	Open hillsides with tall grass	Kensington, Berkeley Hills	Not expected: No suitable habitat present.
San Francisco forktailed damselfly	<i>Ischnura gemina</i>	C3c	Aquatic vegetation in slow or still fresh water	Rohnert Park, Sonoma County	Not expected: Was not detected
Tiburon blind harvestman	<i>Microcina tiburona</i>	C2	Serpentine soils	Ring Mountain, Marin County	Not expected: No suitable habitat present.
California freshwater shrimp	<i>Syncaris pacifica</i>	FE, SE	Low gradient streams with riparian cover	Cuttings Wharf area, Napa County	Not expected: No suitable habitat present.
California brackishwater snail	<i>Tryonia imitator</i>	C2	Coastal lagoons and salt marshes	Petaluma River Marsh, Sonoma County	Not expected: No suitable habitat present; was not detected.

- Notes:
- a. Status of sensitive taxa:
 SE =State Listed As Endangered
 ST =State Listed As Threatened
 SR =Rare in California
 CSC=California Species of Special Concern
 CP =California Fully Protected
 1B =California Native Plant Society, List 1B
 3 =California Native Plant Society, List 3
 FE =Federally Listed As Endangered
 FT =Federally Listed As Threatened
 PE =Federally Proposed Endangered
 C1 =Federal Candidate, Category 1
 C2 =Federal Candidate, Category 2
 C3c =Federal Candidate, Category C3c
 2R =Recommended for Category 2 Status
 - b. Habitat where this taxon typically occurs.
 - c. Reported occurrence of special status species in the vicinity of proposed disposal sites.

**Table C-2. Special-Status Plant and Animal Taxa Occurring or Potentially Occurring
Galbraith Golf Course Site, Alameda County, California**
(page 1 of 5)

<i>Common Name</i>	<i>Scientific Name</i>	<i>Status (a)</i>	<i>Habitat (b)</i>	<i>Reported Localities in Project Area (c)</i>	<i>Potential for Occurrence Onsite (d)</i>
PLANTS					
Alameda manzanita	<i>Arctostaphylos pallida</i>	C1, SE, 1B	Chaparral	Joaquin Miller Park, Alameda County	Not expected: No suitable habitat present onsite.
Monterey spineflower	<i>Chorizanthe pungens</i> var. <i>pungens</i>	FE, 1B	Coastal dunes	Manresa State Beach, Santa Cruz County	Not expected: No suitable habitat present onsite.
robust spineflower	<i>Chorizanthe robusta</i> var. <i>robusta</i>	FE, 1B	Coastal dune, coastal scrub	Alameda County	Low: No suitable habitat present onsite.
Presidio clarkia	<i>Clarkia franciscana</i>	PE, SE, 1B	Coastal scrub, grasslands	Oakland Hills, Alameda County	Not expected: No suitable habitat present onsite.
Pt. Reyes bird's beak	<i>Cordylanthus maritimus</i> ssp. <i>palustris</i>	C2, 1B	Coastal salt marsh	Alameda Marsh, Alameda County	Low: No suitable habitat present onsite.
soft bird's-beak	<i>Cordylanthus mollis</i> ssp. <i>mollis</i>	C2, SR, 1B	Coastal salt marsh	Point Pinole Regional Shoreline, Contra Costa County	Low: No suitable habitat present onsite.
small spike rush	<i>Eleocharis parvula</i>	4	Coastal salt marshes	Antioch Dunes, Contra Costa County	Low: No suitable habitat present onsite.
fragrant fritillary	<i>Fritillaria liliacea</i>	C2, 1B	Heavy soil, open hills and fields near the coast; <200m	Mt. Burdell, Nicasio, Pt. Reyes, Marin County	Low: No suitable habitat present onsite.
marsh gumplant	<i>Grindelia stricta</i> var. <i>angustifolia</i>	4	Coastal salt marsh	San Francisco Bay	Observed offsite.
Diablo helianthella	<i>Helianthella castanea</i>	C2, 1B	Broadleaved upland forest, chaparral	Leona Heights, Alameda County	Not expected: No suitable habitat present onsite.
Congdon's tarplant	<i>Hemizonia parryi</i> ssp. <i>congdonii</i>	C1, 1B	Grassland; <100m	Alameda County 1986, 1930, 1933 no recent occurrences	Not expected: No suitable habitat present onsite.
Santa Cruz tarplant	<i>Holocarpha macradenia</i>	C1, SE, 1B	Coastal prairie; valley and foothill grassland	Adeline Station, Alameda County	Not expected: No suitable habitat present onsite.
wedge-leaved horkelia	<i>Horkelia cuneata</i> ssp. <i>sericea</i>	C2, 1B	Coniferous forest, coastal scrub	Alameda County	Not expected: No suitable habitat present onsite.

**Table C-2. Special-Status Plant and Animal Taxa Occurring or Potentially Occurring
Galbraith Golf Course Site, Alameda County, California**
(page 2 of 5)

<i>Common Name</i>	<i>Scientific Name</i>	<i>Status (a)</i>	<i>Habitat (b)</i>	<i>Reported Localities in Project Area (c)</i>	<i>Potential for Occurrence Onsite (d)</i>
California black walnut	<i>Juglans californica hindsii</i>	C2, 1B	Riparian forest, riparian woodland	Layfayette, Contra Costa County	Low: No suitable habitat present onsite.
Contra Costa goldfields	<i>Lasthenia conjugens</i>	C1, 1B	Vernal pools; valley and foothill grasslands	Newark, Alameda County	Not expected: No suitable habitat present onsite.
Delta tule pea	<i>Lathyrus jepsonii</i> spp. <i>jepsonii</i>	C2, 1B	Fresh to brackish marshes	Southampton Marsh, Solano County	Low: No suitable habitat present onsite.
Mason's lilaeopsis	<i>Lilaeopsis masonii</i>	C2, SR, 1B	Fresh and brackish marshes	Cliff Court Forebay, Alameda County	Not expected: No suitable habitat present onsite.
white-rayed pentachaeta	<i>Pentachaeta bellidiflora</i>	PE, SE, 1B	Valley and foothill grassland	San Quentin Peninsula, Marin County	Not expected: No suitable habitat present onsite.
hairless allocarya	<i>Plagiobothrys glaber</i>	C3a, 1A	Coastal salt marsh	Livermore, Alameda County	Low: No suitable habitat present onsite.
adobe sanicle	<i>Sanicula maritima</i>	C2, SR, 1B	Valley and foothill grasslands	Potrero Hills, San Francisco County	Not expected: No suitable habitat present onsite.
sea blite	<i>Suaeda californica</i>	PE, 1B	Coastal salt marsh	San Leandro, Alameda County	Low: No suitable habitat present onsite.
INVERTEBRATES					
San Francisco forktail damselfly	<i>Ischnura gemina</i>	C3c	Canals, ponds, and marshes	Alameda County	Observed onsite.
California brackishwater snail	<i>Tryonia imitator</i>	C2	Coastal lagoons, creeks, and sloughs	Petaluma River Marsh, Sonoma County	Not expected.
FISH					
green sturgeon	<i>Acipenser medirostris</i>	2R	Large rivers	Sacramento - San Joaquin River System	Not expected: No suitable habitat present onsite.
Chinook salmon (winter-run)	<i>Oncorhynchus tshawytscha</i>	FT, SE	Streams with gravel bottoms	Sacramento - San Joaquin River System	Not expected: No suitable habitat present onsite.
longfin smelt	<i>Spirinchus thaleichthys</i>	2R	Rivers and sloughs	San Francisco Bay	Not expected: No suitable habitat present onsite.

**Table C-2. Special-Status Plant and Animal Taxa Occurring or Potentially Occurring
Galbraith Golf Course Site, Alameda County, California**
(page 3 of 5)

<i>Common Name</i>	<i>Scientific Name</i>	<i>Status (a)</i>	<i>Habitat (b)</i>	<i>Reported Localities in Project Area (c)</i>	<i>Potential for Occurrence Onsite (d)</i>
AMPHIBIANS					
California tiger salamander	<i>Ambystoma californiense</i>	C1, CSC	Annual grasslands, seasonal pools	Livermore Valley, Alameda County	Not expected: Upland habitat features (burrows) absent.
California red-legged frog	<i>Rana aurora draytonii</i>	C1, CSC	Pools of streams, marshes, and in ponds	Alameda County	Not expected: Suitable aquatic habitat absent.
western spadefoot toad	<i>Scaphiopus hammondi hammondi</i>	2R, CSC	Grasslands	Corral Hollow, Alameda County	Not expected: No suitable habitat present onsite.
REPTILES					
northwestern pond turtle	<i>Clemmys marmorata marmorata</i>	C2, CSC	Ponds, lakes, and streams with permanent water	Alameda County	Low: Marginal habitat present onsite.
BIRDS					
Cooper's hawk	<i>Accipiter cooperi</i>	CSC	Woodlands	Alameda County	Observed onsite.
sharp-shinned hawk	<i>Accipiter striatus</i>	CSC	Dense riparian or woodland habitats	Alameda County	Moderate: Site not suitable for nesting.
tricolored blackbird	<i>Agelaius tricolor</i>	C2, CSC	Cattails and tules	Alameda County	Observed onsite.
short-eared owl	<i>Asio flammeus</i>	CSC	Grasslands and marshes	Wildcat Creek Marsh, Contra Costa County	Not expected: No suitable habitat present onsite.
western snowy plover	<i>Charadrius alexandrius nivosus</i>	FT, CSC	Sandy marine and estuarine beaches	Oakland Airport, Alameda County	Not expected: No suitable habitat present onsite.
northern harrier	<i>Circus cyaneus</i>	CSC	Grasslands and marshlands	Oakland, Airport, Alameda County	Moderate: Not expected to nest onsite.
black-shouldered kite	<i>Elanus caeruleus</i>	CP	Variable	Oakland Airport, Alameda County	Moderate: May forage on site.
California horned lark	<i>Eremophila alpestris actia</i>	C2, CSC	Grasslands	Alameda County	Low: Marginal habitat present onsite.
Merlin	<i>Falco columbarius</i>	CSC	Variable	Alameda County	Low: May forage locally.
American peregrine falcon	<i>Falco peregrinus anatum</i>	FE, SE, CP	High cliffs, banks, dunes near water	Oakland Airport, Alameda County	Low: May forage locally.

Mr. Roger Golden, Environmental Resource Planner

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proposed and listed before the subject project is completed. Should the biological assessment reveal that candidate species may be adversely affected, you may wish to contact our office for technical assistance. One of the potential benefits from such technical assistance is that by exploring alternatives early in the planning process, it may be possible to avoid conflicts that could otherwise develop, should a candidate species become listed before the project is completed.

Please contact Laurie Stuart Simons of this office at (916) 978-5408 extension 330 if you have any questions regarding the enclosed list or your responsibilities under the Endangered Species Act. For questions concerning the threatened winter-run chinook salmon, please contact Jim Lecky, Endangered Species Coordinator, at the National Marine Fisheries Service, Southwest Region, 501 West Ocean Boulevard, Suite 4200, Long Beach California 90802-4213, or call him at (310) 980-4015.

Sincerely,

Cay C. Gonder

for

Dale A. Pierce
Acting Field Supervisor

Enclosures

cc: FWS-SFO (Darren Fong, Wetlands, PN19651N39), Sacramento, CA
FWS-SFO (Doug Weinrich, Corps Projects), Sacramento, CA
FWS-SFO (Mike Fris, Corps Projects), Sacramento, CA
NMFS (Jim Lecky), Long Beach, CA

ENCLOSURE A-1

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND
CANDIDATE SPECIES THAT MAY OCCUR IN THE AREA OF THE PROPOSED
OAKLAND HARBOR NAVIGATION IMPROVEMENT PROJECT ALTERNATIVE DISPOSAL SITE:
OAKLAND INNER AND OUTER HARBOR CHANNELS, CALIFORNIA
(1-1-94-SP-415, FEBRUARY 1, 1994)

Listed Species

Fish

winter-run chinook salmon, *Oncorhynchus tshawytscha* (E)

Birds

American peregrine falcon, *Falco peregrinus anatum* (E)

California brown pelican, *Pelecanus occidentalis californicus* (E)

California least tern, *Sterna antillarum (-albifrons) browni* (E)

Plants

Presidio manzanita, *Arctostaphylos hookeri* ssp. *ravenii* (E)

swamp sandwort, *Arenaria paludicola* (E)

beach layia, *Layia carnosa* (E)

Proposed Species

Plants

Tiburon mariposa, *Calochortus tiburonensis* (PT)

Tiburon paintbrush, *Castilleja neglecta* (PE)

Presidio clarkia, *Clarkia franciscana* (PE)

Marin dwarf-flax, *Hesperolinon congestum* (PT)

Tiburon jewelflower, *Streptanthus niger* (PE)

Candidate Species

Fish

green sturgeon, *Acipenser medirostris* (2R)

longfin smelt, *Spirinchus thaleichthys* (2)

Mammals

San Francisco dusky-footed woodrat, *Neotoma fuscipes annectens* (2)

San Joaquin Valley woodrat, *Neotoma fuscipes riparia* (2)

Point Reyes jumping mouse, *Zapus trinotatus orarius* (2)

Pacific western big-eared bat, *Plecotus townsendii townsendii* (2)

greater western mastiff-bat, *Eumops perotis californicus* (2)

Plants

San Francisco manzanita, *Arctostaphylos hookeri* ssp. *franciscana* (2)

pallid manzanita (Alameda manzanita), *Arctostaphylos pallida* (1)

northcoast bird's-beak, *Cordylanthus maritimus* ssp. *palustris* (2)

Oakland Inner and Outer Harbor Channels continued

Plants continued

fragrant fritillary, *Fritillaria liliacea* (2)
San Francisco gumplant, *Grindelia hirsutula* var. *maritima* (2)
pappose spikeweed, *Hemizonia parryi* ssp. *congdonii* (1)
Santa Cruz tarweed, *Holocarpha macradenia* (1)
Kellogg's (wedge-leaved) horkelia, *Horkelia cuneata* ssp. *sericea* (2)
Contra Costa goldfields, *Lasthenia conjugens* (1)
San Francisco lessingia, *Lessingia germanorum* var. *germanorum* (1)
San Francisco popcornflower, *Plagiobothrys diffusus* (2*)
adobe sanicle, *Sanicula maritima* (2)
Marin checkermallow, *Sidalcea hickmanii* ssp. *viridis* (2)
Mission Delores campion, *Silene verecunda* ssp. *verecunda* (2)
most beautiful (uncommon) jewelflower, *Streptanthus albidus* ssp. *peramoenus* (1)
showy Indian clover, *Trifolium amoenum* (2)
San Francisco owl's-clover, *Triphysaria floribunda* (2)

- (E)--Endangered (T)--Threatened (P)--Proposed (CH)--Critical Habitat
(1)--Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.
(2)--Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking. ²
(1R)--Recommended for Category 1 status.
(2R)--Recommended for Category 2 status.
(■)--Listing petitioned.
(*)--Possibly extinct.
(#)--Published 1 year petition finding indicates that taxon warrants listing.

ENCLOSURE A-2

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND
CANDIDATE SPECIES THAT MAY OCCUR IN THE AREA OF THE PROPOSED
OAKLAND HARBOR NAVIGATION IMPROVEMENT PROJECT ALTERNATIVE DISPOSAL SITE:
SONOMA BAYLANDS DISPOSAL SITE, SONOMA COUNTY, CALIFORNIA
(1-1-94-SP-416, FEBRUARY 1, 1994)

Listed Species

Fish

winter-run chinook salmon, *Oncorhynchus tshawytscha* (E)

Birds

California clapper rail, *Rallus longirostris obsoletus* (E)

Mammals

salt marsh harvest mouse, *Reithrodontomys raviventris* (E)

Plants

Baker's stickyseed, *Blennosperma bakeri* (E)

Proposed Species

Fish

tidewater goby, *Euclyclogobius newberryi* (PE)

Sacramento splittail, *Pogonichthys macrolepidotus* (PT)

Plants

Tiburon paintbrush, *Castilleja neglecta* (PE)

Marin dwarf-flax, *Hesperolinon congestum* (PT)

Candidate Species

Fish

longfin smelt, *Spirinchus thaleichthys* (2)

green sturgeon, *Acipenser medirostris* (2R)

Reptiles

northwestern pond turtle, *Clemmys marmorata marmorata* (2)

Birds

black rail, *Laterallus jamaicensis* (2)

San Pablo song sparrow, *Melospiza melodia samuelis* (2)

salt marsh common yellowthroat, *Geothlypis trichas sinuosa* (2)

Mammals

Suisun ornate shrew, *Sorex ornatus sinuosus* (1)

San Francisco dusky-footed woodrat, *Neotoma fuscipes annectens* (2)

Point Reyes jumping mouse, *Zapus trinotatus orarius* (2)

Point Reyes mountain beaver, *Aplodontia rufa phaea* (2)

Pacific western big-eared bat, *Plecotus townsendii townsendii* (2)

greater western mastiff-bat, *Eumops perotis californicus* (2)

Sonoma Baylands Disposal Site continued

Plants

Suisun aster, *Aster chilensis* var. *lentus* (2)
northcoast bird's-beak, *Cordylanthus maritimus* ssp. *palustris* (2)
soft bird's-beak, *Cordylanthus mollis* ssp. *mollis* (1)
Baker's larkspur, *Delphinium bakeri* (1)
fragrant fritillary, *Fritillaria liliacea* (2)
Contra Costa goldfields, *Lasthenia conjugens* (1)
delta tule-pea, *Lathyrus jepsonii* var. *jepsonii* (2)
legenere, *Legenere limosa* (2)
Mason's lilaeopsis, *Lilaeopsis masonii* (2)
Petaluma popcornflower, *Plagiobothrys mollis* var. *vestitus* (2*)
northcoast semaphore grass, *Pleuropogon hooverianus* (2)
Marin knotweed, *Polygonum marinense* (2)
showy Indian clover, *Trifolium amoenum* (2)

- (E)--Endangered (T)--Threatened (P)--Proposed (CH)--Critical Habitat
(1)--Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.
(2)--Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.
(1R)--Recommended for Category 1 status.
(2R)--Recommended for Category 2 status.
(■)--Listing petitioned.
(*)--Possibly extinct.
(#)--Published 1 year petition finding indicates that taxon warrants listing.

ENCLOSURE A-3

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND
CANDIDATE SPECIES THAT MAY OCCUR IN THE AREA OF THE PROPOSED
OAKLAND HARBOR NAVIGATION IMPROVEMENT PROJECT ALTERNATIVE DISPOSAL SITE:
GALBRAITH GOLF COURSE DISPOSAL SITE, ALAMEDA COUNTY, CALIFORNIA
(1-1-94-SP-417, FEBRUARY 1, 1994)

Listed Species

Birds

California clapper rail, *Rallus longirostris obsoletus* (E)

Mammals

salt marsh harvest mouse, *Reithrodontomys raviventris* (E)

Proposed Species

None

Candidate Species

Reptiles

northwestern pond turtle, *Clemmys marmorata marmorata* (2)

southwestern pond turtle, *Clemmys marmorata pallida* (2)

Birds

salt marsh common yellowthroat, *Geothlypis trichas sinuosa* (2)

Alameda (South Bay) song sparrow, *Melospiza melodia pusillula* (2)

Mammals

salt marsh vagrant shrew, *Sorex vagrans halicoetes* (1)

San Francisco dusky-footed woodrat, *Neotoma fuscipes annectens* (2)

San Joaquin Valley woodrat, *Neotoma fuscipes riparia* (2)

Pacific western big-eared bat, *Plecotus townsendii townsendii* (2)

greater western mastiff-bat, *Eumops perotis californicus* (2)

Plants

northcoast bird's-beak, *Cordylanthus maritimus* ssp. *palustris* (2)

fragrant fritillary, *Fritillaria liliacea* (2)

pappose spikeweed, *Hemizonia parryi* ssp. *congdonii* (1)

Santa Cruz tarweed, *Holocarpha macradenia* (1)

Contra Costa goldfields, *Lasthenia conjugens* (1)

Galbraith Golf Course Disposal Site continued

- (E)--Endangered (T)--Threatened (P)--Proposed (CH)--Critical Habitat
- (1)--Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.
- (2)--Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.
- (1R)--Recommended for Category 1 status.
- (2R)--Recommended for Category 2 status.
- (■)--Listing petitioned.
- (*)--Possibly extinct.
- (#)--Published 1 year petition finding indicates that taxon warrants listing.

ENCLOSURE A-4

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND
CANDIDATE SPECIES THAT MAY OCCUR IN THE AREA OF THE PROPOSED
OAKLAND HARBOR NAVIGATION IMPROVEMENT PROJECT ALTERNATIVE DISPOSAL SITE:
MONTEZUMA WETLANDS (LEVIN-FRICKE) DISPOSAL SITE, SOLANO COUNTY, CALIFORNIA
(1-1-94-SP-418, FEBRUARY 1, 1994)

Listed Species

Fish

winter-run chinook salmon, *Oncorhynchus tshawytscha* (E)
delta smelt, *Hypomesus transpacificus* (T)

Birds

California clapper rail, *Rallus longirostris obsoletus* (E)

Mammals

salt marsh harvest mouse, *Reithrodontomys raviventris* (E)
San Joaquin kit fox, *Vulpes macrotis mutica* (E)

Plants

Contra Costa wallflower, *Erysimum capitatum* ssp. *angustatum* (E)
Antioch Dunes evening-primrose, *Oenothera deltoides* ssp. *howellii* (E)

Proposed Species

Fish

Sacramento splittail, *Pogonichthys macrolepidotus* (PT)

Plants

Tiburon paintbrush, *Castilleja neglecta* (PE)
Colusa grass, *Neostapfia colusana* (PT)

Candidate Species

Fish

green sturgeon, *Acipenser medirostris* (2R)
longfin smelt, *Spirinchus thaleichthys* (2)

Reptiles

northwestern pond turtle, *Clemmys marmorata marmorata* (2)

Birds

black rail, *Laterallus jamaicensis* (2)
Suisun song sparrow, *Melospiza melodia maxillaris* (2)
salt marsh common yellowthroat, *Geothlypis trichas sinuosa* (2)

Montezuma Wetland (Levin-Fricke) Disposal Site continued

Mammals

Suisun ornate shrew, *Sorex ornatus sinuosus* (1)
riparian brush rabbit, *Sylvilagus bachmani riparius* (1)
San Francisco dusky-footed woodrat, *Neotoma fuscipes annectens* (2)
San Joaquin Valley woodrat, *Neotoma fuscipes riparia* (2)
Pacific western big-eared bat, *Plecotus townsendii townsendii* (2)
greater western mastiff-bat, *Eumops perotis californicus* (2)

Plants

Suisun aster, *Aster chilensis* var. *lentus* (2)
heartscale, *Atriplex cordulata* (2)
Suisun thistle, *Cirsium hydrophilum* var. *hydrophilum* (1)
hispid bird's-beak, *Cordylanthus mollis* ssp. *hispidus* (2)
soft bird's-beak, *Cordylanthus mollis* ssp. *mollis* (1)
diamond-petaled poppy, *Eschscholzia rhombipetala* (2)
Diablo rock-rose, *Helianthella castanea* (2)
Contra Costa goldfields, *Lasthenia conjugens* (1)
delta tule-pea, *Lathyrus jepsonii* var. *jepsonii* (2)
legenere, *Legenere limosa* (2)
Mason's lilaeopsis, *Lilaeopsis masonii* (2)
Gairdner's yampah, *Perideridia gairdneri* ssp. *gairdneri* (2)

- (E)--Endangered (T)--Threatened (P)--Proposed (CH)--Critical Habitat
(1)--Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.
(2)--Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.
(1R)--Recommended for Category 1 status.
(2R)--Recommended for Category 2 status.
(#)--Listing petitioned.
(*)--Possibly extinct.
(#)--Published 1 year petition finding indicates that taxon warrants listing.

ENCLOSURE A-5

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND
CANDIDATE SPECIES THAT MAY OCCUR IN THE AREA OF THE PROPOSED
OAKLAND HARBOR NAVIGATION IMPROVEMENT PROJECT ALTERNATIVE DISPOSAL SITE:
LEONARD RANCH DISPOSAL SITE, SONOMA COUNTY, CALIFORNIA
(1-1-94-SP-419, FEBRUARY 1, 1994)

Listed Species

Fish

winter-run chinook salmon, *Oncorhynchus tshawytscha* (E)

Plants

Baker's stickyseed, *Blennosperma bakeri* (E)

Proposed Species

Fish

Sacramento splittail, *Pogonichthys macrolepidotus* (PT)
tidewater goby, *Euclyclogobius newberryi* (PE)

Plants

Tiburon paintbrush, *Castilleja neglecta* (PE)

Candidate Species

Fish

green sturgeon, *Acipenser medirostris* (2R)
longfin smelt, *Spirinchus thaleichthys* (2)

Reptiles

northwestern pond turtle, *Clemmys marmorata marmorata* (2)

Mammals

San Francisco dusky-footed woodrat, *Neotoma fuscipes annectens* (2)
San Joaquin Valley woodrat, *Neotoma fuscipes riparia* (2)
Point Reyes jumping mouse, *Zapus trinotatus orarius* (2)
Pacific western big-eared bat, *Plecotus townsendii townsendii* (2)
greater western mastiff-bat, *Eumops perotis californicus* (2)

Plants

Suisun aster, *Aster chilensis* var. *lentus* (2)
Suisun thistle, *Cirsium hydrophilum* var. *hydrophilum* (1)
soft bird's-beak, *Cordylanthus mollis* ssp. *mollis* (1)
Diablo rock-rose, *Helianthella castanea* (2) ‡
Contra Costa goldfields, *Lasthenia conjugens* (1)
delta tule-pea, *Lathyrus jepsonii* var. *jepsonii* (2)
legenere, *Legenere limosa* (2)
Mason's lilaeopsis, *Lilaeopsis masonii* (2)
Marin knotweed, *Polygonum marinense* (2)
showy Indian clover, *Trifolium amoenum* (2)

Leonard Ranch Disposal Site continued

- (E)--Endangered (T)--Threatened (P)--Proposed (CH)--Critical Habitat
- (1)--Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.
- (2)--Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.
- (1R)-Recommended for Category 1 status.
- (2R)-Recommended for Category 2 status.
- (■)--Listing petitioned.
- (*)--Possibly extinct.
- (#)--Published 1 year petition finding indicates that taxon warrants listing.

ENCLOSURE A-6

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND
CANDIDATE SPECIES THAT MAY OCCUR IN THE AREA OF THE PROPOSED
OAKLAND HARBOR NAVIGATION IMPROVEMENT PROJECT ALTERNATIVE DISPOSAL SITE:
BAYFARM ISLAND BORROW AREA DISPOSAL SITE, SAN FRANCISCO SOUTH BAY, CALIFORNIA
(1-1-94-SP-420, FEBRUARY 1, 1994)

Listed Species

Fish

winter-run chinook salmon, *Oncorhynchus tshawytscha* (E)

Birds

California brown pelican, *Pelecanus occidentalis californicus* (E)

California least tern, *Sterna antillarum (-albifrons) browni* (E)

Proposed Species

Plants

Presidio clarkia, *Clarkia franciscana* (PE)

Candidate Species

Fish

green sturgeon, *Acipenser medirostris* (2R)

longfin smelt, *Spirinchus thaleichthys* (2)

Mammals

San Francisco dusky-footed woodrat, *Neotoma fuscipes annectens* (2)

San Joaquin Valley woodrat, *Neotoma fuscipes riparia* (2)

Point Reyes jumping mouse, *Zapus trinotatus orarius* (2)

Pacific western big-eared bat, *Plecotus townsendii townsendii* (2)

greater western mastiff-bat, *Eumops perotis californicus* (2)

Plants

pallid manzanita (Alameda manzanita), *Arctostaphylos pallida* (1)

northcoast bird's-beak, *Cordylanthus maritimus* ssp. *palustris* (2)

fragrant fritillary, *Fritillaria liliacea* (2)

Diablo rock-rose, *Helianthella castanea* (2)

pappose spikeweed, *Hemizonia parryi* ssp. *congdonii* (1)

Santa Cruz tarweed, *Holocarpha macradenia* (1)

Northern California black walnut, *Juglans californica* var. *hindsii* (2)

Contra Costa goldfields, *Lasthenia conjugens* (1)

most beautiful (uncommon) jewelflower, *Streptanthus albidus* ssp.

peramoenus (1)

Bayfarm Island Borrow Area Disposal Site continued

- (E)--Endangered (T)--Threatened (P)--Proposed (CH)--Critical Habitat
- (1)--Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.
- (2)--Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.
- (1R)--Recommended for Category 1 status.
- (2R)--Recommended for Category 2 status.
- (■)--Listing petitioned.
- (*)--Possibly extinct.
- (#)--Published 1 year petition finding indicates that taxon warrants listing.

FEDERAL AGENCIES' RESPONSIBILITIES UNDER
SECTIONS 7(a) and (c) OF THE ENDANGERED SPECIES ACT

SECTION 7(a) Consultation/Conference

Requires: 1) Federal agencies to utilize their authorities to carry out programs to conserve endangered and threatened species; 2) Consultation with FWS when a Federal action may affect a listed endangered or threatened species to insure that any action authorized, funded or carried out by a Federal agency is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. The process is initiated by the Federal agency after determining the action may affect a listed species; and 3) Conference with FWS when a Federal action is likely to jeopardize the continued existence of a proposed species or result in destruction or adverse modification of proposed critical habitat.

SECTION 7(c) Biological Assessment--Major Construction Activity¹

Requires Federal agencies or their designees to prepare a Biological Assessment (BA) for major construction activities. The BA analyzes the effects of the action² on listed and proposed species. The process begins with a Federal agency requesting from FWS a list of proposed and listed threatened and endangered species. The BA should be completed within 180 days after its initiation (or within such a time period as is mutually agreeable). If the BA is not initiated within 90 days of receipt of the list, the accuracy of the species list should be informally verified with our Service. No irreversible commitment of resources is to be made during the BA process which would foreclose reasonable and prudent alternatives to protect endangered species. Planning, design, and administrative actions may proceed; however, no construction may begin.

We recommend the following for inclusion in the BA: an on-site inspection of the area affected by the proposal which may include a detailed survey of the area to determine if the species or suitable habitat are present; a review of literature and scientific data to determine species' distribution, habitat needs, and other biological requirements; interviews with experts, including those within FWS, State conservation departments, universities and others who may have data not yet published in scientific literature; an analysis of the effects of the proposal on the species in terms of individuals and populations, including consideration of indirect effects of the proposal on the species and its habitat; an analysis of alternative actions considered. The BA should document the results, including a discussion of study methods used, any problems encountered, and other relevant information. The BA should conclude whether or not a listed or proposed species will be affected. Upon completion, the BA should be forwarded to our office.

¹ A construction project (or other undertaking having similar physical impacts) which is a major Federal action significantly affecting the quality of the human environment as referred to in NEPA (42 U.S.C. 4332(2)C).

² "Effects of the action" refers to the direct and indirect effects on an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action.

AMERICAN PEREGRINE FALCON

(Falco peregrinus anatum)

CLASSIFICATION:

Endangered 35 Federal Register 16047, October 13, 1970, and 49 Federal Register 10526, March 20, 1984.

CRITICAL HABITAT: Designated in Sonoma, Napa, and Lake Cos.

DESCRIPTION:

A medium-sized, swift flying bird of prey with pointed wings. Wingspan is 3 to 4 feet. Adults have slate gray backs with white underparts that are streaked or barred in black. They have distinctive white and black facial markings.

DISTRIBUTION:

Historically nested throughout North America from the boreal forest south into Mexico, wherever suitable nesting and foraging habitat occurred. Remnant breeding populations currently occur in California, Arizona, New Mexico, Utah, Texas, and Alaska. A few pairs nest in other states in the northeast and northwest.

SPECIAL CONSIDERATIONS:

The American peregrine falcon has suffered major population declines due principally to DDT contamination of their food chain. With the banning of DDT for use in the U.S. in 1972 and implementation of a management program, populations have for the most part stabilized. Unfortunately, pesticide data indicate that there has been a continued input of DDT into the local environments. Some nest sites are now protected from human disturbance. Poor quality eggs are taken from the wild for artificial incubation, and young are placed in nests after hatching from wild eggs taken into captivity or laid by captive parents.

REFERENCES FOR ADDITIONAL INFORMATION:

J. J. Hickey (ed). 1969. Peregrine falcon populations their biology and decline. Univ. of Wisconsin Press. Madison, WI.

Ratcliffe, D. 1980. The peregrine falcon. Buteo Books. Vermillion, SD.

U.S. Fish and Wildlife Service. 1982. Pacific Coast Recovery Plan for the American Peregrine Falcon. Portland, OR. 87 pp.

CALIFORNIA BROWN PELICAN

(Pelicanus occidentalis californicus)

CLASSIFICATION: Endangered - Federal Register 35:16047.

CRITICAL HABITAT: None designated.

DESCRIPTION:

The California brown pelican is a large bird weighing about 9 pounds, with a wingspan of over 6 feet. Adults have long dark bills, about 1.5 feet long, with an elastic gular pouch for catching and holding fish, which turns bright red during the breeding season. Coloration is generally brownish, with white patterning on the head and neck.

DISTRIBUTION:

One of six recognized subspecies, nesting distribution is restricted to islands in the Gulf of California, and along the outer coast from Baja California to the Southern California Bight. In the U.S., nesting rookeries are located on Anacapa Island and Santa Barbara Island. During the non-breeding season, the California brown pelican ranges northward along the Pacific coast from the Gulf of California to Washington and southern British Columbia.

SPECIAL CONSIDERATION:

The California brown pelican also is listed as endangered by the State of California, and therefore, is protected by State law. The entire species was listed, except breeding populations along the U.S. Atlantic coast, Florida, and Alabama, because of widespread pollutant-related reproductive failures during the late 1960's and early 1970's. Although breeding populations have rebounded since the elimination of DDT use, persistent residues in the coastal environment continue to cause chronic reproductive problems.

REFERENCES FOR ADDITIONAL INFORMATION:

- U.S. Fish and Wildlife Service. 1983. The California brown pelican recovery plan. Portland, OR. Prepared under contract with Frank Gress and Dan Anderson.
- Anderson, D. and F. Gress. 1983. Status in a northern population of California brown pelicans. Condor 85:79-88.
- Anderson, D. F. Gress and K. Mais. 1982. Brown pelicans: influence of food supply on reproduction. Oikos 39:23-31.
- Anderson, D., J. Jehl, R. Risebrough, L. Woods, L. Deweese, and W. Edgecomb. 1975. Brown pelicans: improved reproduction off the southern California coast. Science 190:806-808.

CALIFORNIA LEAST TERN
[*Sterna antillarum* (=albifrons) browni]

CLASSIFICATION:

Endangered (35 **Federal Register** 16047, October 13, 1970).

CRITICAL HABITAT:

None designated.

DESCRIPTION:

Least terns are the smallest members of the subfamily Sterninae (family Laridae), measuring about 22.9 cm (nine inches) long with a 50.8 cm (20 inch) wingspread. Sexes look alike, being characterized by a black cap, gray wings with black wingtips, orange legs, and black-tipped yellow bill. Immature birds have a darker plumage and a dark bill, and their white heads with dark eye stripes are quite distinctive. The California least tern cannot be reliably differentiated from other races of the least tern on the basis of plumage characteristics alone.

DISTRIBUTION:

The California least tern is migratory, usually arriving in its breeding area the last week of April and departing again in August (Davis 1968, Masses 1974, Swickard 1971). The historical breeding range of this subspecies has usually been described as extending along the Pacific Coast from Moss Landing, Monterey County, California, to San Jose del Cabo, southern Baja California, Mexico (AOU 1957, Dawson 1924, Grinnell 1928, Grinnell and Miller 1944). However, least terns were nesting several miles north of Moss Landing at the mouth of the Pajaro River, Santa Cruz County, California, at least from 1939 (W. E. Unglish, Western Foundation of Vertebrate Zoology egg collection) to 1954 (Pray 1954).

Since 1970, nesting sites have been recorded from San Francisco Bay to Bahia de San Quintin Baja California. The nesting range in California has apparently always been widely discontinuous, with the majority of birds nesting in southern California from Santa Barbara County south through San Diego County. Between the city of Santa Barbara and Monterey Bay, a distance of over 322 km (200 miles), the only known regularly used breeding locations are within 16.1 km (10 miles) of the mouths of the Santa Ynez and Santa Maria rivers in Santa Barbara County.

In Baja California, two nest sites are identified in the literature: Scammons Lagoon (Bancroft 1927, Grinnell 1928), and San Jose del Cabo (Grinnell 1928, Lamb 1927). In 1975, a nesting colony was found near Ensenada. (Massey 1977) and in 1976, a small colony was discovered at Bahia de San Quintin. Several other nesting areas in Baja California, including Magdalena Bay, San Felipe, and Bahia de San Quintin. Several other nesting areas in Baja California, including Magdalena Bay, San Felipe, and Bahia de Los Angeles are suspected.

The least tern usually chooses nesting locations in an open expanse of light-colored sand, dirt or dried mud close to a lagoon or estuary with a dependable food supply (Craig 1971, Swickard 1971, Massey 1974). Formerly sandy beaches regularly were used, but increased human activity on most beaches has made many of them unsuitable. As a result, terns have been forced to nest on mud and sand flats back from the ocean, and on non-natural habitats such as airports and land fills.

SPECIAL CONSIDERATIONS:

The State of California listed the California least tern as an endangered species in 1980.

REFERENCES FOR ADDITIONAL INFORMATION: -

U.S. Fish and Wildlife Service. In press. California least tern recovery plan. Endangered Species Program. Portland, OR. 112 pp.

Massey, B. 1972. Breeding biology of California least terns. Master's thesis. Calif. State. Univ., Long Beach, CA.

Massey, B., and J. Atwood. 1981. Application of ecological information to habitat management for the California least tern progress rept. no. 3. Unpubl. rept. to U.S. Fish and Wildlife Service, Ecological Services, Laguna Niguel, CA.

Note: Complete citations for all papers references in this account are found in the recovery plan.

CALIFORNIA CLAPPER RAIL
(*Rallus longirostris obsoletus*)

CLASSIFICATION:

Endangered (Federal Register Vol. 35, No. 199:16047, October 13, 1970).

CRITICAL HABITAT:

None designated

DESCRIPTION:

Similar to other subspecies of clapper rail, but grayish brown above with light ochraceous buff or tawny breast; flanks grayish brown barred with white; and white patch under short, upcocked tail. Iris reddish orange, bill orange yellow at base, brownish distally; legs and feet brownish gray. Downy young black with greenish olive above. Legs 57 mm; toes 51 mm; bill 59 mm; weight about 330 g.

DISTRIBUTION:

Marin, Sonoma, Napa, Solano, Contra Costa, Alameda, Santa Clara, San Mateo, and Monterey counties. Extirpated from Humboldt and San Luis Obispo counties. The estimated population of 1,600 to 2,400 rails is largely centered in the tidal marshes of south San Francisco Bay. Smaller, more widely scattered populations occur in the tidal marshes ordering San Pablo and Suisun Bays, with an extra-limital location at Elkhorn Slough (Monterey).

SPECIAL CONSIDERATIONS:

Prime habitat consists of large salt marshes (dominated by *Salicornia virginica* and *Spartina foliosa*) with well-developed tidal slough networks, along which rails forage for invertebrates. Although rails have been documented in brackish marshes as well, use in these habitats is not as well understood. Rails typically build near nests tidal sloughs, at lower marsh elevations. Also listed as endangered by State of California.

REFERENCES FOR ADDITIONAL INFORMATION:

Gill, R. 1979. Status and distribution of the California clapper rail (*Rallus longirostris obsoletus*). Calif. Fish and Game 65(1):36-49.

U.S. Fish and Wildlife Service. 1984. Salt marsh harvest mouse and California clapper rail recovery plan. November 16, 1984. USFWS, Sacramento Endangered Species Office.

SALT MARSH HARVEST MOUSE

(*Reithrodontomys raviventris*)

CLASSIFICATION:

Endangered (Federal Register Vol. 35, No. 199:16047, October 13, 1970).

CRITICAL HABITAT: None designated.

DESCRIPTION:

Clinal variation throughout its range, but generally very similar to western harvest mouse (*R. megalotis*). Tail/body ratio; tail thickness, shape, and coloration; venter color; in combination with typically darker dorsal coloration, ochraceous tufts of hairs at anterior base of ears, and generally placid behavior, are useful characteristics to distinguish from *R. megalotis*.

DISTRIBUTION:

Marin, Sonoma, Napa, Solano, Contra Costa, Alameda, Santa Clara, and San Mateo counties. The northern subspecies, *R. r. halicoetes*, occurs north of Point San Pedro (Marin) and Point Pinole (Contra Costa) in tidal and non-tidal wetlands bordering San Pablo Bay, the Petaluma and Napa Rivers, and Suisun Bay east to Collinsville and Antioch. The southern subspecies, *R. r. raviventris*, occurs in tidal and non-tidal wetlands from Points Pinole and San Pedro south to the Alviso district.

SPECIAL CONSIDERATIONS:

Unable to survive the rigors of daily tidal inundation at lower marsh elevations, the species historically inhabited mid-to higher elevation tidal wetlands and transitional upland habitats. Currently, the species inhabits a variety of non-tidal habitats as well, including salt, brackish and freshwater wetlands, and adjacent uplands to a distance at least 150 feet from the wetland edge. Key determinants of habitat suitability include moderate to dense vegetative cover and escape habitat from high waters. Although pickleweed (*Salicornia virginica*) is usually a major botanical component, a diverse mixture of annual and perennial, herbaceous vegetation, including ruderal and alien species, often characterizes transitional upland habitats frequented by the species. Also listed as endangered by State of California.

REFERENCES FOR ADDITIONAL INFORMATION:

Fisler, G. 1965. Adaptations and speciation in harvest mice of the marshes of San Francisco Bay. Univ. Calif. Publ. in Zool. 77:1-108.

U.S. Fish and Wildlife Service. 1984. The salt marsh harvest mouse and California clapper rail recovery plan. November 16, 1984. USFWS, Sacramento Endangered Species Office.

permit accordingly. Channel 267B can be allotted to Charlotte Amalie in compliance with the Commission's minimum distance separation requirements at petitioner's present construction site with a site restriction of 20 kilometers (12.9 miles) east. The coordinates for channel 267B at Charlotte Amalie are North Latitude 18-20-30 and West Longitude 64-43-59.

DATES: Comments must be filed on or before January 4, 1993, and reply comments on or before January 19, 1993.

ADDRESSES: Federal Communications Commission, Washington, DC 20554. In addition to filing comments with the FCC, interested parties should serve the petitioner, or its counsel or consultant, as follows: Arthur V. Belendiuk, Esq., Smithwick and Belendiuk, P.C., 1990 M Street, NW., suite 510, Washington, DC 20036 (Counsel for Petitioner).

FOR FURTHER INFORMATION CONTACT: Sharon P. McDonald, Mass Media Bureau, (202) 634-6530.

SUPPLEMENTARY INFORMATION: This is a synopsis of the Commission's Notice of Proposed Rule Making, MM Docket No. 92-244, adopted October 1, 1992, and released November 10, 1992. The full text of this Commission decision is available for inspection and copying during normal business hours in the FCC Dockets Branch (Room 230), 1919 M Street, NW., Washington, DC. The complete text of this decision may also be purchased from the Commission's copy contractor, Downtown Copy Center, (202) 452-1422, 1990 M Street, NW., suite 640, Washington, DC 20036.

Provisions of the Regulatory Flexibility Act of 1980 do not apply to this proceeding.

Members of the public should note that from the time a Notice of Proposed Rule Making is issued until the matter is no longer subject to Commission consideration or court review, all *ex parte* contacts are prohibited in Commission proceedings, such as this one, which involve channel allotments. See 47 CFR 1.1204(b) for rules governing permissible *ex parte* contacts.

For information regarding proper filing procedures for comments, see 47 CFR 1.415 and 1.420.

List of Subjects in 47 CFR Part 73

Radio broadcasting.

Federal Communications Commission.

Michael C. Rager,

Chief, Allocations Branch, Policy and Rules Division, Mass Media Bureau.

[FR Doc. 92-30063 Filed 12-10-92; 8:45 am]

BILLING CODE 4713-01-M

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

RIN 1018-AB66

Endangered and Threatened Wildlife and Plants; Proposed Endangered Status for the Tidewater Goby

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Proposed rule.

SUMMARY: The Fish and Wildlife Service (Service) proposes to list the tidewater goby (*Eucyclogobius newberryi*) as endangered, as provided by section 4 of the Endangered Species Act of 1973, as amended (Act). The tidewater goby is a fish that occurs in tidal streams associated with coastal wetlands in California. This species has significantly declined throughout its historic range and continues to be threatened by loss and degradation of its coastal habitat. Since 1900, the tidewater goby has disappeared from nearly 50 percent of the coastal lagoons within its historic range, including 74 percent of the lagoons south of Morro Bay. Only three populations currently exist south of Ventura County. The Service seeks comments and data from the public on this proposed rule.

DATES: Comments from all interested parties must be received by February 9, 1993. Public hearing requests must be received by January 25, 1993.

ADDRESSES: Comments and materials concerning this proposal should be sent to Office Supervisor, U.S. Fish and Wildlife Service, Ventura Field Office, 2140 Eastman Avenue, suite 100, Ventura, California 93003 (telephone 805/644-1766). Comments and materials received will be available for public inspection, by appointment, during normal business hours at the above address.

FOR FURTHER INFORMATION CONTACT: Donna C. Brewer, Ventura Field Office (see ADDRESSES section).

SUPPLEMENTARY INFORMATION:

Background

The tidewater goby, *Eucyclogobius newberryi* (Girard), is a small fish, rarely exceeding 50 mm (2 inches) standard length, and is characterized by large pectoral fins and a ventral sucker-like disk formed by the complete fusion of the pelvic fins. The tidewater goby was first described as a new species (*Gobius newberryi*) by Girard (1856) from specimens collected in the San Francisco Bay area. Based on Girard's

specimens, Gill (1862) reassigned *Gobius newberryi* to the newly described genus *Eucyclogobius* (Eschmeyer 1990).

A member of the family Gobiidae, the tidewater goby is the only species in the genus *Eucyclogobius* and is almost unique among fishes along the U.S. Pacific coast in its restriction to low-salinity waters in California's coastal wetlands. All life stages of tidewater gobies are found at the upper end of lagoons in salinities less than 10 parts per thousand (ppt). Although its closest relatives are marine species, the tidewater goby does not have a marine life history phase. This lack of a marine phase severely restricts the frequency of genetic exchange between coastal lagoon populations and significantly lowers the potential for natural recolonization of a locality once extirpated. Studies by Crabtree (1985) noted that some populations of gobies have differentiated genetically, indicating long isolation. Tidewater gobies have a shorter lifespan, and seem to be an annual species (Swift 1990; Irwin and Stoltz 1984), further restricting their potential to recolonize habitats from which they have been extirpated.

The tidewater goby occurs in shallow water (less than 1 meter (3 ft) deep), on the substrate, in loose aggregations of a few to several hundred individuals (Swift *et al.* 1989). Peak nesting activities commence in late April or early May, when male gobies dig a vertical nesting burrow 10-20 centimeters (4-8 in) deep in clean, coarse sand. Suitable water temperatures for nesting are 18-22 °C with salinities of 5-10 ppt. Male gobies remain in the burrows to guard eggs, which are hung from the ceiling and walls of the burrow until hatching. Larval gobies are found midwater around vegetation until they become benthic (Swift *et al.* 1989). Although the potential for year-round spawning exists, it is probably unlikely, because of seasonal low temperatures and disruptions of lagoons during winter storms. Although usually associated with lagoons, the tidewater goby has been documented in ponded freshwater habitats as far as 8 km (5 miles) upstream from San Antonio lagoon in Santa Barbara County (Irwin and Stoltz 1984).

Currently, the tidewater goby is discontinuously distributed throughout California, ranging from Tillas Slough (mouth of the Smith River), Del Norte County, south to Agua Hedionda Lagoon in San Diego County. Areas of precipitous coastlines that preclude the formation of lagoons at stream mouths

have created three natural gaps in the distribution of the goby. Gobies are apparently absent from three sections of the coast, between: (1) Humboldt Bay and Ten Mile River, (2) Point Arena and Salmon Creek, and (3) Monterey Bay and Arroyo del Oso.

Roughly 10 percent of the coastal lagoons presently containing populations of tidewater goby are under Federal ownership. Over 40 percent of the remaining populations are either wholly or partly owned and managed by the State of California. The remainder are privately owned.

Previous Federal Action

The tidewater goby was first classified by the Service as a category 2 species in 1982 (47 FR 58454). It was reclassified as a category 1 candidate in 1991 (56 FR 58804) based on status and threat information in Swift *et al.* (1989). Category 2 applies to taxa for which information in the possession of the Service indicates that proposing to list as endangered or threatened is possibly appropriate, but for which conclusive data on biological vulnerability and threat are not available to support proposed rules. Category 1 applies to taxa for which the Service has on file substantial information on biological vulnerability and threats to support proposals to list them as endangered or threatened species. On October 24, 1990, the Service received a petition from Dr. Camm Swift, Associate Curator of Fishes at the Los Angeles Museum of Natural History, to list the tidewater goby as endangered (Swift 1990). The Service's finding that this petition presented substantial information that the requested action may be warranted was published on March 22, 1991 (56 FR 12146). Following this finding, the Service initiated a status review on the tidewater goby.

Section 4(b)(3)(B) of the Endangered Species Act (Act), as amended in 1982, requires the Secretary to make a finding within 12 months of the date a petition is received as to whether or not the requested action is warranted. Based on the additional information supplied by Dr. Swift's petition, this proposed rule constitutes the Service's finding that the petitioned action is warranted. The petition, status surveys, and accompanying data describe the goby as imperiled owing to past and continuing wide-ranging losses of coastal and riparian habitats within its historic range.

Summary of Factors Affecting the Species

Section 4 of the Endangered Species Act (16 U.S.C. 1531 *et seq.*) and

regulations (50 CFR part 424) promulgated to implement the listing provisions of the Act set forth the procedures for adding species to the Federal Lists. A species may be determined to be an endangered or threatened species due to one or more of the five factors described in section 4(a)(1). These factors and their application to the tidewater goby (*Eucyclogobius newberryi*) are as follows:

A. The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range

Coastal development projects that result in the loss of coastal saltmarsh habitat are currently the major factor affecting the tidewater goby. Coastal marsh habitats have been drained and reclaimed for residential and industrial developments, and waterways have been dredged for navigation and harbors, resulting in permanent and direct losses of wetland habitats as well as indirect losses due to associated changes in salinity. Coastal road construction projects have severed the connection between marshes and the ocean, resulting in unnatural temperature and salinity profiles that the tidewater goby cannot tolerate.

Furthermore, upstream water diversions adversely affect the tidewater goby by altering downstream flows, thereby diminishing the extent of marsh habitats that occurred historically at the mouths of most rivers and creeks in California. Alterations of flows upstream of coastal lagoons has already changed the distribution of downstream salinity regimes. Since the tidewater goby has relatively narrow salinity tolerances, changes in salinity distributions due to upstream water diversions may adversely affect both the size and distribution of goby populations (D. Holland, Univ. of Southwestern Louisiana, pers. comm., 1991).

Historically, the tidewater goby occurred in at least 87 of California's coastal lagoons (Swift *et al.* 1989). Since 1900, it has disappeared from approximately 50 percent of formerly occupied lagoons. A rangewide status survey conducted in 1984 found that 22 historic populations of tidewater goby had been extirpated (Swift *et al.* 1989). Only 5 years later, a subsequent status survey documented the disappearance of an additional 21 populations. In the San Francisco Bay area, 9 of 10 previously identified populations have disappeared (Swift *et al.* 1989, 1990). Losses in the southern part of the State have been greatest, including 74 percent of the coastal lagoons south of Morro

Bay. Only three populations currently remain south of Ventura County. Since 1989, three additional tidewater goby populations have been lost, in San Luis Obispo and Santa Cruz counties (Swift *et al.* 1989, 1990). Five small populations have been rediscovered since 1984, but the overall losses indicate a decline of 35 percent rangewide in only 6 years (Holland 1991a, 1991b, 1991c; Swift *et al.* 1991).

Of the 43 remaining populations of tidewater gobies identified by Swift *et al.* (1990), most are small and threatened by a variety of both human and natural factors. According to Swift *et al.* (1990), only 6 extant localities contain populations that are considered large enough and free enough from habitat degradation to be safe for the immediate future. These areas are all located north of San Francisco Bay. The remaining lagoons are so small or so modified that tidewater goby populations are restricted in distribution and vulnerable to elimination (Swift *et al.* 1989, 1990). The number of extirpated localities of gobies has left remaining populations so widely separated throughout most of its range that recolonization is unlikely.

Several specific proposed and ongoing coastal development activities threaten habitats supporting tidewater gobies, including (1) road widening and bridge replacement projects along Highway 101, (2) water diversion projects in San Luis Obispo County, (3) expansion of several State Park Recreation areas in Santa Barbara and San Luis Obispo Counties, and (4) hotel and golf course developments in San Luis Obispo and Marin Counties.

In addition to these specific threats, the tidewater goby is vulnerable throughout its remaining range because of the loss of coastal marsh, as noted above and because of other effects of water diversions as well. In addition to restricting the goby's overall range by altering downstream salinities, water diversions and alternations of water flows may negatively impact the species' breeding and foraging activities. Gobies in southern and central California breed primarily in sand/mud substrates and apparently avoid areas that contain large amounts of decaying vegetation (Holland 1991b). Reductions in water flows may allow aggressive plant species to colonize the otherwise bare sand/mud substrates of coastal lagoon margins, thus degrading the habitat quality for the goby. Decreases in stream flows also reduce the deep stream pools utilized by gobies venturing upstream from lagoons. In San Luis Obispo County alone, the effects of drought, either directly or

exacerbated by upstream water diversions, have been responsible for the extirpation of at least three populations of gobies between 1986 and 1990 (K. Worcester, Calif. Dept. Fish Game, pers. comm., 1991).

The tidewater goby is also adversely affected by groundwater overdrafting and discharge of agricultural and sewage effluents. In Santa Barbara, for example, increased groundwater pumpage and siltation from topsoil runoff in the San Antonio Creek drainage has significantly affected areas immediately upstream of occupied goby habitat (i.e., Barka Slough) (C. Swift, Los Angeles County Museum of Natural History, pers. comm., 1991). Swift *et al.* (1989) cite evidence that enrichment by agricultural and sewage effluents may cause algal blooms and deoxygenation that restrict habitable areas of lagoons utilized by tidewater gobies, especially in summer. The potential for these factors to degrade remaining goby habitats has also been noted at all three extant localities south of Ventura County (D. Holland, pers. comm., 1991), and at several sites along the central California coast (T. Taylor, Calif. State Parks and Recreation, pers. comm. 1991; K. Worcester, pers. comm., 1991).

The tidewater goby is further threatened by channelization of the rivers it inhabits. Because most of the goby's localities have been moderately to extremely channelized, winter floods scour the species out of the restricted channelized areas where no protection is afforded from such high flows. This type of event was responsible for the disappearance of gobies from Waddell Creek lagoon in the winter 1972-73 (C. Swift, pers. comm., 1991), and they have not returned.

Finally, cattle grazing and feral pig activities also present a threat to the existence of the tidewater goby. These activities have resulted in increased sedimentation of coastal lagoons and riparian habitats, removal of vegetative cover, increased ambient water temperatures, and elimination of plunge pools and collapsed undercut banks utilized by tidewater gobies. In San Luis Obispo County, increased sedimentation into Morro Bay has significantly accelerated the conversion of wetland habitats to upland (Josselyn *et al.* 1989). Presently, cattle continue to graze freely both upstream and in many of the coastal lagoons supporting tidewater gobies (K. Worcester, pers. comm., 1991).

B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Not known to be applicable.

C. Disease or Predation

Over the past 20 years, at least 60 species of fishes have been introduced to the western states, 59 percent of which are predatory (Hayes and Jennings 1986, Jennings 1988). The introduction of exotic predators to southern California waters has been facilitated by the interbasin transport of water (e.g., California Aqueduct). Introduced predators, particularly centrarchid fishes, may have contributed to the elimination of tidewater gobies from several localities in California (Swift *et al.* 1989). The present-day absence of the tidewater gobies from the San Francisco delta area may well be explained by the presence of introduced predators such as striped bass (*Morone saxatilis*) and native predators including the Sacramento perch (*Archoplites interruptus*) (Swift *et al.* 1989, 1990). Two of the most recent disappearances of gobies from San Luis Obispo County (Old Creek) and San Diego County (San Onofre Creek) are likely due to the presence of largemouth bass (*Micropterus salmoides*) and green sunfish (*Lepomis cyanellus*), respectively. Natural predation on gobies by rainbow trout (*Oncorhynchus mykiss*) has been documented (Swift *et al.* 1989). Other non-native predators, specifically crayfish (*Cambarus spp.*) and mosquitofish (*Gambusia spp.*), may also threaten goby populations through direct predation on adults, larvae, or eggs.

D. The Inadequacy of Existing Regulatory Mechanisms

Section 10 of the Rivers and Harbors Act and section 404 of the Clean Water Act regulate the placement of dredge and fill materials into waters of the United States. Under section 404, nationwide permits, which undergo minimal public and agency review, can be issued for projects involving less than 10 acres of waters of the United States and adjacent wetlands, unless a listed species may be adversely affected. Individual permits, which are subject to more extensive review, are required for projects that affect greater than 10 acres.

The U.S. Army Corps of Engineers (Corps) is the agency responsible for administering the section 10 and section 404 programs. The Service, as part of the section 404 review process, provides comments on both pre-discharge notices for nationwide permits and public notices for individual permits. The Service's comments are only advisory, although procedures exist for elevation when disagreements between the agencies arise. In practice, the Corps' actions under section 10 and section

404 are insufficient to protect the tidewater goby.

Most projects within the range of the tidewater goby may require approval from the Corps as currently described in section 404 of the Clean Water Act. Projects proposed in coastal lagoons may also require a permit under section 10 of the Rivers and Harbors Act. Federal listing of this species would ensure greater consideration of the effects of permitted actions during the review process as well as provide the protections of section 7 of the Endangered Species Act.

The National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) require an intensive environmental review of projects that may adversely affect Federal candidate species. However, project proponents are not required to avoid impacts to this species, and proposed mitigation measures are frequently not adequately implemented. As with section 404 permits, the Service's comments through these environmental review processes are only advisory.

The California Coastal Act (CCA) regulates the approval of developments within the coastal zone. The continued loss and degradation of coastal wetlands since the CCA was enacted in 1974 attests to the limitations of this legislation, although a significant slowing in wetland losses has occurred.

E. Other Natural or Manmade Factors Affecting its Continued Existence

By far, the most significant natural factor adversely affecting the tidewater goby is drought, and resultant deterioration of coastal and riparian habitats. California has recently experienced 5 consecutive years of lower than average rainfall. These drought conditions, when combined with human induced water reductions (i.e., diversions of water from streams, excessive groundwater withdrawals) have degraded coastal and riparian ecosystems and have created extremely stressful conditions for most aquatic species. Formerly large populations of tidewater gobies have declined in numbers owing to reduced availability of suitable lagoon habitats (i.e., San Simeon Creek, Pico Creek), others disappeared owing to lack of water when the lagoons dried (i.e., Santa Rosa Creek). In San Luis Obispo County alone, 6 of 20 populations of tidewater gobies were extirpated between 1984 and 1989 owing to drought coupled with water diversions and pollution (K. Worcester, pers. comm., 1991).

Habitat degradation and losses of the tidewater goby from weather-related

natural phenomena commonly occur, due to the restriction of the species to coastal lagoon systems and its dependence on freshwater inflows. Events such as river flooding and heavy rainfall have been reported to destroy goby burrows and wash gobies out to sea. Storm surges that enter a lagoon may also adversely affect entire goby populations by rapidly changing salinity.

The tidewater goby was undoubtedly subjected to such natural flood events even before major human alteration of drainage basins. As mentioned under Factor A, channelization and urbanization have increased the frequency and perhaps the intensity of such flood events. In addition, populations of gobies are becoming more isolated from one another as intervening populations are extirpated, thus further decreasing the likelihood of successfully colonizing and reestablishing a population lost to a "natural" flood.

Competition with introduced species is a potential threat to the tidewater goby. Although problems have not been documented so far, the spread of two introduced oriental gobies (the yellowfin goby, *Acanthogobius flavimanus*, and chameleon goby, *Tridentiger trigonocephalus*) may have a detrimental effect on the tidewater goby. According to Swift *et al.* (1990), the chameleon goby was recently found in Pyramid Lake, probably imported with central California water. If this goby becomes established in the Santa Clara River as other imported species have (e.g., *Cottus asper*), the tidewater goby population at the mouth of the Santa Clara River may be at risk.

The Service has carefully assessed the best scientific and commercial information available regarding the past, present, and future threats faced by this species in determining to propose this rule. The tidewater goby has been extirpated from nearly 50 percent of the lagoons within its historic range, including 74 percent of the lagoons south of Morro Bay. Forty-three populations remain; however, only 6 are large in number and reasonably free from immediate threats. Based on this evaluation, the preferred action is to list the tidewater goby as endangered. The tidewater goby has experienced substantial declines throughout its historic range, lives within specific habitat zones that have been, and will continue to be targeted for development and suffer degradation by human activities, and are extremely vulnerable to adverse habitat modification and to water quality changes. The tidewater goby is in imminent danger of extinction

throughout its range and requires the full protection of listing as endangered under the Act in order to survive. For the reasons discussed below, critical habitat is not being proposed at this time.

Critical Habitat

Section 4(a)(3) of the Act, as amended, requires that, to the maximum extent prudent and determinable, the Secretary designate critical habitat concurrently with determining a species to be endangered or threatened. Furthermore, the Service is to designate critical habitat on the basis of the best scientific and commercial data available after taking into consideration the economic, and other relevant impacts of specifying an area as critical habitat (16 U.S.C. 1533(b)(2)). In the case of the tidewater goby, critical habitat is not presently determinable. A final designation of critical habitat requires detailed information on the possible economic effects of such a designation. The Service does not currently have sufficient information needed to perform the economic analysis. A delay in the proposed listing of the species in order to gather additional information and perform analyses would not serve the needs of the species. The Service will continue to gather information on this species, and will publish a determination on the designation of critical habitat at a later date.

Available Conservation Measures

Conservation measures provided to species listed as endangered or threatened under the Endangered Species Act include recognition, recovery actions, requirements for Federal protection, and prohibitions against certain activities. Recognition through listing encourages and results in conservation actions by Federal, State, and private agencies, groups, and individuals. The Endangered Species Act provides for possible land acquisition and cooperation with the States and requires that recovery actions be carried out for all listed species. The protection required of Federal agencies and the prohibitions against taking and harm are discussed, in part, below.

Section 7(a) of the Act, as amended, requires Federal agencies to evaluate their actions with respect to any species that is proposed or listed as endangered or threatened and with respect to its critical habitat, if any is being designated. Regulations implementing this interagency cooperation provision of the Act as codified at 50 CFR part 402. Section 7(a)(4) of the Act requires Federal agencies to confer informally with the Service on any action that is

likely to jeopardize the continued existence of a proposed species or result in destruction or adverse modification of proposed critical habitat. If a species is listed subsequently, section 7(a)(2) requires Federal agencies to insure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of such a species or to destroy or adversely modify its critical habitat. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency must enter into formal consultation with the Service.

A number of Federal agencies or departments control lands that support the tidewater goby. These agencies include the Department of Defense (U.S. Army Corps of Engineers, U.S. Navy, U.S. Air Force, and U.S. Marine Corps) and Department of the Interior (National Park Service and U.S. Fish and Wildlife Service). Federal actions that may be affected by this proposal would be the funding or authorization of projects within the species' habitat, including the construction of roads, bridges, and dredging projects subject to section 404 of the Clean Water Act (33 U.S.C. 1344 *et seq.*) and section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 401 *et seq.*), and special use permits. Other Federal actions that are subject to environmental review under the National Environmental Policy Act would also require consultation with the Service. Projects on federally owned land would also be subject to the provisions of section 7 of the Endangered Species Act.

The Act and implementing regulations found at 50 CFR 17.21 set forth a series of general prohibitions and exceptions that apply to all endangered wildlife. These prohibitions, in part, would make it illegal for any person subject to the jurisdiction of the United States to take (includes harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect; or attempt any of these), import or export, transport in interstate or foreign commerce in the course of commercial activity, or sell or offer for sale in interstate or foreign commerce any listed species. It also is illegal to possess, sell, deliver, carry, transport, or ship any such wildlife that has been taken illegally. Certain exceptions apply to agents of the Service and State conservation agencies.

The Act and 50 CFR 17.22 and 17.23 also provide for the issuance of permits to carry out otherwise prohibited activities involving endangered wildlife species under certain circumstances. Such permits are available for scientific purposes, to enhance the propagation or survival of the species, for incidental

take in connection with otherwise lawful activities, and for economic hardship under certain circumstances. Requests for copies of the regulations on listed plants and wildlife and inquiries regarding them may be addressed to the Office of Management Authority, U.S. Fish and Wildlife Service, Room 432, 4401 North Fairfax Drive, Arlington, Virginia 22203-3507 (703/358-2104).

Public Comments Solicited

The Service intends that any final action resulting from this proposal will be as accurate and as effective as possible. Therefore, comments or suggestions from the public, other concerned governmental agencies, the scientific community, industry, or any other interested party concerning this proposed rule are hereby solicited. Comments particularly are sought concerning:

(1) Biological, commercial trade, or other relevant data concerning any threat (or lack thereof) to this species:

(2) The location of any additional populations of this species and the reasons why any habitat should or should not be determined to be critical habitat as provided by section 4 of the Act;

(3) Additional information concerning the range, distribution, and population size of this species; and

(4) Current or planned activities in the subject area and their possible impacts on this species.

Any final decision on this proposal will take into consideration the comments and any additional information received by the Service, and such communications may lead to a final regulation that differs from this proposal.

The Endangered Species Act provides for a public hearing on this proposal, if requested. Requests must be received within 45 days of the date of publication of the proposal. Such requests must be made in writing and addressed to the Office Supervisor at the Ventura Field Office (see ADDRESSES section).

National Environmental Policy Act

The Fish and Wildlife Service has determined that an Environmental Assessment, as defined under the authority of the National Environmental Policy Act of 1969, need not be prepared in connection with regulations adopted pursuant to section 4(a) of the Endangered Species Act of 1973, as amended. A notice outlining the Service's reasons for this determination was published in the Federal Register on October 25, 1983 (48 FR 49244).

References Cited

A complete list of all references cited herein, as well as others is available

upon request from the Ventura Field Office (see ADDRESSES section).

Author

The primary authors of this proposed rule are Donna C. Brewer and Cathy Brown of the Ventura Field Office (see ADDRESSES section).

List of Subjects in 50 CFR Part 17

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, and Transportation.

Proposed Regulation Promulgation

PART 17—(AMENDED)

Accordingly, it is hereby proposed to amend part 17, subchapter B of chapter I, Title 50 of the Code of Federal Regulations, as set forth below:

1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361-1407; 16 U.S.C. 1531-1544; 16 U.S.C. 4201-4245; Public Law 99-625, 100 Stat. 3500; unless otherwise noted.

2. It is proposed to amend § 17.11(h) by adding the following, in alphabetical order under Fishes to the List of Endangered and Threatened Wildlife:

§ 17.12 Endangered and threatened wildlife.

(h) * * *

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
FISHES							
Goby, tidewater	<i>Eucyclogobius newberryi</i>	U.S.A. (CA)	Endre	E		NA	NA

Dated: November 27, 1992.
Bruce Blanchard,
Acting Director, Fish and Wildlife Service.
[FR Doc. 92-30175 Filed 12-10-92; 8:45 am]
BILLING CODE 4310-25-M

50 CFR Part 17

RIN 1018-AB83

Endangered and Threatened Wildlife and Plants; Proposal To List the Relict Darter and Bluemask (=Jewel) Darters as Endangered Species

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Proposed rule.

SUMMARY: The U.S. Fish and Wildlife Service (Service) proposes to list the relict darter (*Etheostoma chienense* and bluemask (=jewel) darter (*Etheostoma*

(*Doration*) sp.) as endangered under the Endangered Species Act of 1973, as amended (Act). The relict darter, which is endemic to the Bayou du Chien drainage in western Kentucky, has been collected from only five sites within this drainage and is known to spawn in only one Bayou du Chien tributary. The relict darter has been and continues to be impacted by poor water quality and habitat deterioration resulting from stream channelization, siltation caused by poor land use practices, and by other water pollutants. The bluemask darter is endemic to the Caney Fork River system (above Great Falls), Cumberland River

affected by one or more of the express written contracts permitted by S4.1.5.2.2 of § 571.208 of this chapter shall:

(A) Report the existence of each such contract, including the names of all parties to the contract, and explain how the contract affects the report being filed; and

(B) Report the number of cars covered by each such contract.

(2) *Trucks, buses, and multipurpose passenger vehicles.*

(i) *Automatic crash protection.*

(A) *Basis for phase-in production goals.* Each manufacturer shall report the number of trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less that it manufactured for sale in the United States for each of the three preceding production years, or, at the manufacturer's option, for the production year for which the report is filed. A manufacturer that did not manufacture any trucks, buses, or multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less during each of the three preceding production years must report the number of trucks, buses, or multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less it manufactured during the production year for which the report is filed. However, manufacturers are not required to report any information with respect to those vehicles that are manufactured in two or more stages, walk-in van-type trucks, vehicles designed to be sold exclusively to the U.S. Postal Service, and/or vehicles that are altered after previously having been certified in accordance with part 567 of this chapter.

(B) *Production.* Each manufacturer shall report for the production year for which the report is filed, and for each preceding production year, to the extent that trucks, buses, and multipurpose passenger vehicles produced during the preceding production years are treated under § 571.208 of this chapter as having been produced during the production period for which the report is filed, the information specified in paragraphs (d)(2)(i)(B)(1) through (d)(2)(i)(B)(3) of this section, inclusive, with respect to its trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less.

(1) The number of those vehicles certified as complying with S4.1.2.1 of Standard No. 208 (49 CFR 571.208)

because they are equipped with automatic seat belts and the seating positions at which those belts are installed;

(2) The number of those vehicles certified as complying with S4.1.2.1 of Standard No. 208 (49 CFR 571.208) because they are equipped with air bags and the seating positions at which those air bags are installed; and

(3) The number of those vehicles certified as complying with S4.1.2.1 of Standard No. 208 (49 CFR 571.208) because they are equipped with other forms of automatic crash protection, which forms of automatic crash protection shall be described, and the seating positions at which those forms of automatic crash protection are installed.

(C) *Vehicles produced by more than one manufacturer.* Each manufacturer whose reporting of information is affected by one or more of the express written contracts permitted by S4.2.5.6.2 of § 571.208 of this chapter shall:

(1) Report the existence of each such contract, including the names of all parties to the contract, and explain how the contract affects the report being filed; and

(2) Report the number of vehicles covered by each such contract.

(ii) *Inflatable restraint system that provides automatic crash protection.*

(A) *Basis for phase-in production goals.* Each manufacturer shall report the total number of trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less that it manufactured for sale in the United States for the production year ending August 31, 1998. However, manufacturers are not required to report any information with respect to those vehicles that are walk-in van-type trucks, and/or vehicles designed to be sold exclusively to the U.S. Postal Service.

(B) *Production.* Each manufacturer shall report the number of trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds that it manufactured for sale in the United States for the production year ending August 31, 1998 that it certified as complying with S4.1.5.1(a) of Standard No. 208 (§ 571.208 of this chapter) because they were equipped with an inflatable restraint system that provided automatic crash protection.

(C) *Vehicles produced by more than one manufacturer.* Each manufacturer whose reporting of information is affected by one or more of the express written contracts permitted by

S4.2.6.1.2 of § 571.208 of this chapter shall:

(1) Report the existence of each such contract, including the names of all parties to the contract, and explain how the contract affects the report being filed; and

(2) Report the number of vehicles covered by each such contract.

12. Section 585.6 would be revised to read as follows:

§ 585.6 Records.

Each manufacturer shall maintain records of the vehicle identification number and type of automatic crash protection for each vehicle for which information was reported under § 585.5 until December 31, 1999.

Issued on December 8, 1992.

Barry Felrice,

Associate Administrator for Rulemaking.

[FR Doc. 92-30213 Filed 12-11-92; 8:45 am]

BILLING CODE 4010-00-01

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

RIN 1018-AB55

Endangered and Threatened Wildlife and Plants; Proposed Endangered Status for Ten Plants and Threatened Status for Two Plants From Serpentine Habitats in the San Francisco Bay Region of California

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Proposed rule.

SUMMARY: The U.S. Fish and Wildlife Service (Service) proposes endangered status pursuant to the Endangered Species Act of 1973, as amended (Act) for 10 plants: *Castilleja neglecta* (Tiburon paintbrush), *Ceanothus ferrisae* (coyote ceanothus), *Cirsium fontinale* var. *fontinale* (fountain thistle), *Clarkia franciscana* (Presidio clarkia), *Cordylanthus tenuis* ssp. *capillaris* (Pennell's bird's beak), *Dudleya setchellii* (Santa Clara Valley dudleys), *Eriophyllum latilobum* (San Mateo woolly sunflower), *Pentstemon bellidiflora* (white-rayed pentstemon), *Streptanthus albidus* ssp. *albidus* (Metcalf Canyon jewelflower), and *Streptanthus niger* (Tiburon jewelflower). The Service also proposes threatened status for two plants, *Calochortus tiburonensis* (Tiburon mariposa lily) and *Hesperalinon congestum* (Marin dwarf-flax). These species are restricted to serpentine soil outcrops in the area near the San

Francisco Bay, California. The 12 plants have been affected variously and are threatened by one or more of the following: Urbanization, pedestrian and off-road vehicular traffic, the invasion of alien plants, road maintenance, soil erosion and slipping, unauthorized dumping, livestock grazing, seed predation by beetles, and stochastic extinction by virtue of the small isolated nature of the remaining populations. This proposal, if made final, would implement the Federal protection and recovery provisions afforded by the Act for these plants. The Service seeks data and comments from the public on this proposal.

DATES: Comments from all interested parties must be received by February 12, 1993. Public hearing requests must be received by January 28, 1993.

ADDRESSES: Comments and materials concerning this proposal should be sent to the Field Supervisor, U.S. Fish and Wildlife Service, 2800 Cottage Way, room E-1803, Sacramento, California 95825-1846. Comments and materials received will be available for public inspection, by appointment, during normal business hours at the above address.

FOR FURTHER INFORMATION CONTACT: Jeanine L. Hardison at 916/978-4866 (see ADDRESSES section).

SUPPLEMENTARY INFORMATION:

Background

Cordylanthus tenuis ssp. *capillaris*, *Calochortus tiburonensis*, *Castilleja neglecta*, *Streptanthus niger*, *Clarkia franciscana*, *Cirsium fontinale* var. *fontinale*, *Eriophyllum latilobum*, *Hesperolinon congestum*, *Pentachaeta bellidiflora*, *Ceanothus ferrisiae*, *Dadleya setchellii*, and *Streptanthus albidus* ssp. *albidus* are endemic to serpentine soils in the region of the San Francisco Bay in California. Serpentine soils are derived from ultramafic rocks such as serpentinite, dunite, and peridotite, which are found in discontinuous outcrops in the Sierra Nevada and in the Coast Ranges from Santa Barbara County, California, to British Columbia. The chief constituent of the parent rock is some variant of iron-magnesium silicate. Most serpentine soils are formed in place over the parent rock, and are therefore shallow, rocky, and highly erodible. Serpentine soils also, because of the parent material, tend to have high concentrations of magnesium, chromium, and nickel, and low concentrations of calcium, nitrogen, potassium, and phosphorus (Kruckeberg 1984). These characteristics make serpentine soil inhospitable for the growth of most plants. Nevertheless,

some plants have adapted to the rigors of life on serpentine soils. In fact, serpentine soils often support a high diversity of plants, including many rare species (McCarten 1988). Over 200 taxa in California are endemic (restricted) to serpentine soils (Kruckeberg 1984).

Serpentine soils in the San Francisco Bay region are derived from intrusive igneous rocks associated with fault zones in the sedimentary Franciscan formation. Outcrops occur south of the Bay in the Coyote Valley of Santa Clara County; west of the Bay at Edgewood County Park, near Crystal Springs Reservoir, and at Stanford University's Jasper Ridge Preserve in San Mateo County, and at the Presidio in San Francisco County; east of the Bay in the Oakland hills of Alameda County and at Mt. Diablo in Contra Costa County; and north of the Bay on the Tiburon Peninsula in eastern Marin County and at Mt. Tamalpais, Carson Ridge, and near Nicasio Reservoir in western Marin County, as well as in Sonoma and Napa Counties.

Serpentine soils are variable in soil chemistry, texture, and water availability, both within and between sites (McCarten 1987b). This variability and the variety of micro-climates in the San Francisco Bay region have a profound effect upon the local flora and vegetation. Several serpentine plant communities are found in the San Francisco Bay region (McCarten 1987b). Grassland and annual forb communities (serpentine bunchgrass grassland and serpentine wildflower field) tend to occur on level ground or on gentle slopes with soils to 1 meter (m) (3 feet (ft)) or more in depth. Shrub communities (Franciscan serpentine coastal scrub, mixed serpentine chaparral, and Sargent cypress woodlands) tend to occur on steep rocky slopes with shallow soils. In some areas, soil development is minimal and parent rock is extensively exposed. These serpentine barrens support a distinctive community composed of only a few species, usually growing at low densities. Another unique habitat on serpentine soils occurs near seasonal springs and seeps, which support species requiring moist soil. Most of the 12 species proposed in this rule occur in the serpentine bunchgrass grassland and serpentine wildflower field communities. *Cirsium fontinale* var. *fontinale* occurs in serpentine seep areas. *Cordylanthus tenuis* ssp. *capillaris* and *Ceanothus ferrisiae* occur in chaparral, as do a few populations of *Hesperolinon congestum*. *Dadleya setchellii* and *Streptanthus albidus* ssp. *albidus* are found on serpentine barrens. *Eriophyllum latilobum* grows on

serpentine-influenced soil in the coast live oak woodland community.

Serpentine endemics may have limited or widespread distributions. Some species are restricted to a single outcrop; others occur on serpentine soils within a particular region; a few species occur throughout almost the entire range of serpentine soils in California (Kruckeberg 1984). Of the taxa proposed in this rule, one (*Calochortus tiburonensis*) is thought to always have been restricted to the single outcrop on which it occurs. Others, including *Cordylanthus tenuis* ssp. *capillaris*, *Streptanthus niger*, *Eriophyllum latilobum*, *Dadleya setchellii*, and *Streptanthus albidus* ssp. *albidus*, have a known historical range of only a few miles or less. The widest ranging species in historic times was *Pentachaeta bellidiflora*, which occurred from Marin County to Santa Cruz County. It is now restricted to a single population as a result of habitat destruction.

The human population of the San Francisco Bay region has grown rapidly over the last several decades. Urban development (including highway construction) has reduced the amount of serpentine habitat by nearly 20 percent in the past 28 years (McCarten 1987b). The construction of roads, houses, recreational facilities, and waste disposal sites continues. The increasing numbers of people also place an ever greater strain on undeveloped wildlands, through activities such as pedestrian and off-road vehicle traffic, unauthorized garbage dumping, and changes in the pattern of wildland fires. Serpentine habitats, because of their often limited vegetative cover, may appear to the uninitiated as unoccupied space, and so they are especially likely to be subject to disturbances. Recreational activities may directly impact plants; or may result in increased erosion and facilitate the invasion of alien species including many introduced annual grasses common in California. Competition with introduced species is a serious threat to serpentine natives (McCarten 1987b). The destruction of serpentine habitats due to urban development has also increased the fragmentation of rare plant populations, thus increasing the risks of extinction due to chance events such as fire, pest or disease outbreaks, reproductive failure, or other natural or human-caused disaster.

The land that supports these 12 taxa is owned by cities and counties, State and Federal agencies, parks, two water districts and private parties.

Discussion of the Twelve Species Proposed for Listing

North Bay Species

Cordylanthus tenuis ssp. *capillaris* (Pennell's bird's beak) was collected by Herbert Mason about 3 kilometers (km) (2 miles) north of Occidental in Sonoma County, California, in 1946. Francis Whittier Pennell described the plant as *Cordylanthus capillaris* in 1950, using Mason's specimen as the type (Pennell 1950). Pennell was misled by an erroneous label to think that the plants had been collected in Merced County (Bacigalupi 1966), which may have affected his treatment of the taxon (Chuang and Heckard 1986). Artificial hybridization studies of *C. brunneus* and *C. capillaris* (Chuang and Heckard 1975) showed a close relationship between the two plants. The name *C. brunneus* ssp. *capillaris* was proposed for *C. capillaris* by Chuang and Heckard (Heckard 1977) but was never formally published. In 1986 Chuang and Heckard published a revision of the genus, in which both *C. brunneus* and *C. capillaris* were treated as subspecies of *C. tenuis* (Chuang and Heckard 1986).

Cordylanthus tenuis ssp. *capillaris* is a branching herbaceous annual of the snapdragon family (Scrophulariaceae). The plant grows 30–40 centimeters (cm) (12–16 inches (in)) tall, with yellow-green hairless herbage that becomes purplish with age. The leaves are entire, or those of the primary stem three-parted, and threadlike. The floral bracts are three-parted up to two-thirds of their length, with fine marginal hairs on bracts and calyx. The tubular corolla is 1.5 cm (0.6 in) long, and garnet-brown laterally, paler dorsally. Each capsule contains 10–16 seeds. The three-lobed outer bracts of *Cordylanthus tenuis* ssp. *capillaris* distinguish it from its nearest relative (*C. tenuis* ssp. *brunneus*) and from *C. pilosus*, another *Cordylanthus* found in the area. A further distinguishing character is that *C. pilosus* is densely hairy throughout.

Cordylanthus tenuis ssp. *capillaris* is known only from two locations: the type locality in western Sonoma County and a second occurrence a few miles to the west. A third population may occur on property adjacent to the second location, but permission for botanical surveys on that property has been consistently refused (Betty Guggolz, Milo Baker Chapter, California Native Plant Society, pers. comm., 1992). The total number of plants fluctuates from year to year, as is typical of annual plants. *C. tenuis* ssp. *capillaris* is threatened with potential residential development, garbage dumping, and roadside maintenance.

Calochortus tiburonensis (Tiburon mariposa lily) was discovered in 1971 by Robert West on Ring Mountain on the Tiburon Peninsula in Marin County, California. Albert Hill collected the type specimen on Ring Mountain the following year, and published the description in 1973 (Hill 1973).

Calochortus tiburonensis is a bulbous perennial of the lily family (Liliaceae) with a single persistent, basal, linear-oblong leaf 30–60 cm (1–2 ft) long. The flowering stem, about 50 cm (20 in) tall, is usually branched and bears erect flowers in twos or threes at the ends of the branches. The three petals and three sepals are light yellow-green with reddish or purplish-brown markings. The capsule is triangular in cross-section, and about 4 cm (2 in) long. The long slender hairs on the upper surface and margins of the petals and the lack of wings on the capsule distinguish *Calochortus tiburonensis* from the other two *Calochortus* species found on the Tiburon Peninsula, *C. umbellatus* and *C. luteus*.

Calochortus tiburonensis is known only from its type locality, where it grows on rocky serpentine slopes among annual and perennial herbs and grasses. The population, estimated at 40,000 individuals in 1991 (Larry Serpa, The Nature Conservancy, pers. comm., 1992), occurs on land which has been owned and managed by The Nature Conservancy since 1982. The occurrence of this plant in a single population and its proximity to human development activities renders it vulnerable to catastrophic events such as fire, disease or pest outbreak, severe drought, or other natural or human-caused disasters.

The type specimen of *Castilleja neglecta* (Tiburon paintbrush) was collected by Katherine Brandegee in the early 1900s. The plant was described by Zeile (1925) in Willis Jepson's *Manual of the Flowering Plants of California*.

Castilleja neglecta is a semi-woody perennial of the snapdragon family (Scrophulariaceae), with erect, branched stems 30–60 cm (1–2 ft) tall and a sparse covering of soft, spreading hairs. The lance-shaped leaves have one or two pairs of narrow lobes. The conspicuous floral bracts are yellowish and sometimes red-tipped; the flowers are yellow to red and 18–20 millimeters (mm) (0.7–0.8 in) long. The simple (unbranched) hairs and the lack of glands below the inflorescence distinguish *C. neglecta* from other species of *Castilleja* on the Tiburon Peninsula (*C. latifolia* var. *rubra* and *C. foliosa*) (Howell 1970).

Castilleja neglecta occurs in serpentine bunchgrass communities on north to west facing slopes. It is known from four populations in Marin County, three of which occur on the Tiburon Peninsula, and one population in Napa County. The range of this plant is approximately 50 km (30 miles) from east to west, and 35 km (22 miles) from north to south. Population sizes are small, ranging from 50 plants at a location in western Marin County (Martin 1991) to 600 plants at Ring Mountain Preserve on the Tiburon Peninsula (Hunter 1989a). A total of approximately 1,500 plants exist. The Marin County populations are threatened by residential development, foot traffic, grazing, and soil slumping; the Napa County population is threatened by gravel mining and grazing.

Streptanthus niger (Tiburon jewelflower) was described by Edward L. Greene, who cited as the type a specimen he had collected at St. Hilary's Church in the town of Tiburon in Marin County (Greene 1886a). Greene later redefined the limits of *Euclisia*, formerly a subgenus of *Streptanthus*, treating it as a genus in its own right (Greene 1904). *Streptanthus niger*, as a member of the *Euclisia* group, was thus referred to as *Euclisia niger*. Jepson (1925) returned *Euclisia* to subsection status, and later authors followed his treatment. Munz treated *S. niger* as a subspecies of *S. glandulosus* in *A California Flora* (1959), and then returned it to *S. niger* in his supplement (1968), following Kruckeberg (1958).

Streptanthus niger is an annual herb of the mustard family (Brassicaceae) that reaches 30–60 cm (1–2 ft) in height. The lower leaves are toothed, the upper leaves less toothed or not at all. The sepals are a very dark purple; the petals have a purple claw and a white blade with a purple midvein. The zig-zag inflorescence pattern and the lack of hairs distinguish *S. niger* from its near relative *S. glandulosus*.

Streptanthus niger is found on shallow rocky serpentine soils on southwest-facing slopes on the Tiburon Peninsula of Marin County. Two populations are known from the southern end of the peninsula where they occur within 3 km (2 miles) of one another. Populations number from 50 to 2,000 plants (Hunter 1989b; Andrew Allen, Belvedere-Tiburon Landmarks Society, in litt., 1991). The plant is threatened by residential development, foot traffic, and road construction.

Central Bay Species

The type specimen of *Clarkia franciscana* (Presidio clarkia) was

collected by Peter Raven in 1956. *C. franciscana* was described by Harlan Lewis and Peter Raven (1958).

Clarkia franciscana is a slender, erect, herbaceous annual of the evening-primrose family (Onagraceae) to 40 cm (16 in) tall with few, very small and narrow leaves. The lavender-pink petals have a lighter basal portion and a reddish-purple basal spot. The slender capsule is 2–4 cm (1–2 in) long. *Clarkia franciscana* can be distinguished from *Clarkia rubicunda*, a related species which may occur in the same area, by the fact that its petals have irregular teeth on the apical margin (*C. rubicunda* has petals that are rounded at the apex).

Clarkia franciscana is restricted to serpentine soils in grassland communities in San Francisco and Alameda Counties. Two populations are known from the Presidio in San Francisco. Three populations are known from the Oakland Hills in Alameda County, 27 km (17 miles) east of San Francisco, and all from within 0.6 miles of each other. A fourth population in the Oakland Hills was reported in 1988 (California Department of Fish and Game, Natural Diversity Data Base), but could not be relocated in a search conducted in 1991 (David Bigham, East Bay Chapter, California Native Plant Society, in litt., 1991). Population sizes fluctuate greatly; the upper limit to the total numbers of plants reported in recent years is approximately 8,000 plants. The first of the Alameda County populations was discovered in 1980 at the Redwood Regional Park. Because this discovery occurred so long after the original discovery of the plant, and because this population was relatively far from the previously known population at the Presidio, it was suggested that this population might not be a natural occurrence. This suggestion gained credence from the fact that seed collected from the type location in 1964 had been sown in the East Bay Regional Parks Tilden Botanic Garden and plants grown there for several years (Roof 1971). Seed collected from plants at the botanic garden had been sown in several sites at the Presidio in 1972 (Roof 1972). It was thought that seed might also have been sown at Redwood Regional Park in Alameda County. However, an electrophoretic comparison of the San Francisco and Alameda populations "strongly suggests that the Oakland Hills population did not originate by seed transfer from San Francisco, and that it must be regarded as indigenous to its present locality" (Gottlieb and Edwards 1992). *C. franciscana* is threatened by potential development, roadside maintenance, foot traffic, mowing, competition from alien plants,

and shade from native and introduced shrubs and trees.

Cirsium fontinale var. *fontinale* (fountain thistle) was first described as *Cnicus fontinalis* (Greene 1886b). In 1892 Greene reassigned the plant to the genus *Carduus* (Greene 1892). Willis Jepson, in his *Flora of Western Middle California* (1901), put the taxon in the genus *Cirsium*. In 1938 John Thomas Howell described a close relative of the fountain thistle, *Cirsium fontinale* var. *obispoense* (Chorro Creek bog thistle) (Howell 1938). According to the rules for botanical nomenclature, when a new variety is described in a species not previously divided into infraspecific taxa, a "type" variety is automatically created. In this case, the type variety is *C. fontinale* var. *fontinale*.

Cirsium fontinale var. *fontinale* is an herbaceous perennial of the aster family (Asteraceae) with several stout, erect reddish stems 30–60 cm (1–2 ft) high. The basal leaves are 10–20 cm (4–8 in) long with spine-tipped lobes; the leaves on the stems are smaller. The flowers are dull white to pinkish, becoming brown with age. The egg-shaped, recurved bracts beneath the flower head distinguish *Cirsium fontinale* var. *fontinale* from the most similar thistle in the area, brownie thistle (*Cirsium quercetorum*). The nearest relative of *C. fontinale* var. *fontinale*, *Cirsium fontinale* var. *obispoense*, is found further south, in San Luis Obispo County.

Cirsium fontinale var. *fontinale* is restricted to perpetually moist clay openings in riparian or serpentine chaparral. Historically, this plant occurred in both San Mateo and Santa Clara Counties, but it is now found in only three locations in San Mateo County. One population of 1,000–2,000 plants occurs east of Crystal Springs Reservoir, on both sides of Interstate 280. A second population of 100–200 plants occurs 10 km (6 miles) to the south in the "Triangle area," a triangular piece of land west of Edgewood County Park, which is bounded by Interstate 280 to the east, Edgewood Road on the north, and Canada Road on the west. A single plant was found in Edgewood County Park in 1987. In 1992, there was still only one plant in this location (Susan Sommers, Santa Clara Valley Chapter, California Native Plant Society, pers. comm., 1992). The taxon is threatened by proposed recreational development, competition with alien plant species, garbage dumping, and roadside maintenance.

Eriophyllum latilobum (San Mateo woolly sunflower) was first collected by Elmer in 1903. The type specimen was

collected by A.A. Heller in 1907. The plant was described by Per Axel Rydberg (1915). *E. latilobum* is believed to have originated as a hybrid between *E. confertiflorum* and *E. lanatum* var. *arachnoideum* (Munz 1959; John Mooring, Santa Clara University, pers. comm. 1992).

Eriophyllum latilobum is a bushy perennial of the aster family (Asteraceae) with leafy stems 30–40 cm (12–16 in) high. The upper surfaces of the deeply three-cleft leaves are a smooth dark green and the lower surfaces are covered with densely interwoven white hairs. The golden flower heads are borne in loose clusters. *E. latilobum* differs from *E. confertiflorum* in having eight ray flowers rather than five, large flower heads, and a more open inflorescence. *E. lanatum* var. *arachnoideum* differs from the other two species in having 13 ray flowers and shallowly cleft leaves.

Eriophyllum latilobum is found in shaded moist sites on steep grassy or sparsely wooded slopes of serpentine-influenced soil. The single remaining occurrence of *E. latilobum* consists of a few hundred plants scattered along 4 km (2.5 miles) of Crystal Springs Road in San Mateo County. These subpopulations are probably the fragments of a once-continuous population. *E. latilobum* has also been reported from southern San Mateo County, on Pescadero Road southwest La Honda, but this report is most likely erroneous. At least one of the specimens collected at this site (in 1929) is actual *Eriophyllum confertiflorum* (Barry Prigge, University of California, Los Angeles herbarium, pers. comm., 1992 and searches in recent years have found only *Eriophyllum confertiflorum* (Tom Correll, Santa Clara Valley Chapter, California Native Plant Society, pers. comm., 1992). The plant is threatened by erosion and soil slippage, road maintenance, garbage dumping, and recreational development.

The type specimen of *Hesperolinon congestum* (Marin dwarf-flax) was collected in Marin County by Henry Nicholas Bolander in 1863, while working on the State Geological Survey. Asa Gray described the new species as *Linum congestum*, including it in the section *Hesperolinon* which he described in the same paper (Gray 1865). J.K. Small (1907) established *Hesperolinon* as a distinct genus in 1907. Jepson (1925) treated *Hesperolinon* as a section of the genus *Linum*, and treated *H. congestum* as subspecies of *L. californicum*. Helen Sharsmith (1961) conducted an extensive study of *Hesperolinon* and concluded that it definitely warranted

distinction as a separate genus. She also returned *H. congestum* to the status of a species.

Hesperolinon congestum is an herbaceous annual of the flax family (Linaceae) with slender, threadlike stems, 10–40 cm (4–16 in) tall. The leaves are linear. The flowers are borne in congested clusters; the pedicels are 0.2–2 mm (.01–.08 in) long. The sepals are hairy and the five petals are rose to whitish. The anthers are deep pink to purple; this character helps distinguish *H. congestum* from *H. californicum*, found in the same geographic area, which has white to rose anthers, as well as hairless sepals. Two other species that are found in the same region are *H. micranthum* and *H. spergulinum*. They differ from *H. congestum* in having hairless sepals and a long, open inflorescence, with pedicels 2–25 mm (.08–1 in) long.

Hesperolinon congestum is endemic to serpentine soils from Marin County south to San Mateo County, a range of 80 km (50 miles). Two populations are found in serpentine chaparral; the others occur in serpentine bunchgrass habitat. There are six populations known from Marin County, one from San Francisco County, and seven from San Mateo County. Populations fluctuate in size from hundreds to thousands of plants (Robison and Morey 1992a). The species is threatened with residential and recreational development, foot traffic, and competition from alien species.

Pentachaeta bellidiflora (white-rayed pentachaeta) was first collected in 1853–54 near Corte Madera by John Milton Bigelow, surgeon and botanist for a railway route exploration (Van Horn 1973). The plant was described as *Pentachaeta bellidiflora* (Greene 1885). Keck (1958) transferred the entire genus to *Chaetopappa*. Van Horn (1973) studied *Chaetopappa* and *Pentachaeta* and concluded that the two genera are not closely related. Based on differences in floral and vegetative morphology and chromosome number, Van Horn reinstated the genus *Pentachaeta*.

Pentachaeta bellidiflora is a small annual plant of the aster family (Asteraceae) with one or a few branches that bear narrow, linear leaves. Each flower head has numerous yellow disk florets and 5 to 16 white to purplish ray florets. The fruits are tawny, coarse-haired achenes (dry one-seeded fruits). Related species in the San Francisco Bay area (*P. exilis* ssp. *exilis* and *P. alsinoides*) differ from *P. bellidiflora* in that they have no ray flowers.

Pentachaeta bellidiflora is known only from one location, in a serpentine bunchgrass community in San Mateo

County. Historically, *P. bellidiflora* was known from at least nine sites in Marin, San Mateo, and Santa Cruz Counties. The other populations have been destroyed by urbanization, off-road vehicles, or highway construction over the past 50 years (Robison and Morey 1992b). As is common among annual plants, the size of this population fluctuates dramatically from year to year. Numbers have ranged from 10,000 to just under 100 million in the last 10 years, with about 1.5 million plants growing in each of the last 2 years (Zoe Chandik, Santa Clara Valley Chapter, California Native Plant Society, pers. comm., 1992). The species is threatened by recreational development.

South Bay Species

Ceanothus ferrisae (coyote ceanothus) was collected in 1917 by LeRoy Abrams, professor of botany at Stanford University, on Madrone Springs Road above Coyote Creek, in Santa Clara County. The species was described in 1933 by Howard E. McMinn (McMinn 1933), professor of botany at Mills College and author of *An Illustrated Manual of California Shrubs*.

Ceanothus ferrisae is an erect evergreen shrub of the buckthorn family (Rhamnaceae) that grows 1–2 m (3–6 ft) high, with long stiff divergent branches. Its round leaves are dark green and hairless on the upper surface, lighter green with minute hairs below. The leaf margins have short teeth or sometimes no teeth at all; the leaf base is abruptly tapering or rounded. The small white flowers are borne in clusters 1.3–2.5 cm (0.5–1 in) long. The seed capsules are 7–9 mm (.3–.35 in) in width and have three conspicuous apical horns. The related *C. cuneatus* has entire leaves with wedge-shaped (not rounded) bases and seed capsules only 5–6 mm (.2 in) wide.

Ceanothus ferrisae grows on dry slopes in serpentine chaparral. It is known from only three locations, all within 6 km (4 miles) of each other, in Santa Clara County. Fewer than 6,000 plants are known to exist. It was thought at one time to occur in both San Mateo and Santa Cruz Counties as well, but these reports have been found to be erroneous (Corelli 1991). The existing populations are threatened by residential and recreational development and unauthorized dumping.

The type specimen of *Dudleya setchellii* (Santa Clara Valley dudleya) was collected by Willis L. Jepson in 1896 on Tulare Hill in Santa Clara County. He described it as *Cotyledon laxa* var. *setchellii* (Jepson 1901). At the same time, he described *Cotyledon*

caespitosa var. *paniculata*, which he had collected from Morrison Canyon near what is now Fremont. Britton and Rose (1903) elevated both taxa to full species and transferred them to the newly-created genus *Dudleya*. Subsequently, *Dudleya setchellii* was variously treated as *Cotyledon setchellii* (Fedde 1904), *Echeveria setchellii* (Nelson and Macbride 1913), and *Echeveria laxa* var. *setchellii* (Jepson 1936). Reid Moran (1959) combined the material referred to as *Dudleya setchellii* and *D. paniculata* in *D. cymosa* ssp. *setchellii*. Kai Nakai (1987) separated the two entities into *D. cymosa* ssp. *paniculata* and *D. cymosa* ssp. *setchellii* on the basis of leaf shape, inflorescence branching patterns, and pedicel length. Jim Bartel contends that *D. setchellii* should not be placed within *D. cymosa*, and is in fact intermediate to *D. cymosa* and *D. abramsii* (Jim Bartel, U.S. Fish and Wildlife Service, pers. comm., 1992). His forthcoming treatment of *Dudleya* retains Nakai's *D. cymosa* ssp. *paniculata* and resurrects Britton and Rose's *D. setchellii* for the Santa Clara Valley dudleya (Bartel in press).

Dudleya setchellii is a low-growing perennial of the stonecrop family (Crassulaceae) with fleshy, glabrous leaves. The oblong to triangular, slightly glaucous leaves are 3–8 cm (1–3 in) long and 7–15 mm (0.3–0.6 in) wide. Two or three flowering stems ascend to heights of 5–20 cm (2–8 in) in mid to late spring. The pale yellow petals are 8–13 mm (0.3–0.5 in) long. There are two related species in the area. *D. cymosa* ssp. *cymosa* has bright yellow to red petals rather than pale yellow, and is therefore easily distinguished from *D. setchellii* with its pale yellow flowers. *D. cymosa* ssp. *paniculata* can be distinguished from *D. setchellii* by its oblong to oblanceolate leaves (in contrast to the oblong-triangular leaves of *D. setchellii*), its greater degree of rebranching of the inflorescence branches, and its longer pedicels.

Dudleya setchellii is restricted to rocky outcrops within serpentine grasslands in Santa Clara County. It is found only in the Coyote Valley area, from San Jose south about 30 km (20 miles) to San Martin, at elevations of 100–300 m (300–900 ft). *D. cymosa* ssp. *paniculata* ranges from Contra Costa County to Fresno and Monterey Counties; the reports of Moran's combination *D. cymosa* ssp. *setchellii* from Alameda, Contra Costa, and San Benito Counties (Munz 1959, Olson and Lake 1991) reflect the distribution of *D. cymosa* ssp. *paniculata* and do not refer to *D. setchellii* as now recognized. Fourteen sites and a total of 12,000–13,000 plants are known to exist. The

plant is threatened by development, unauthorized dumping, and off-road vehicles.

Streptanthus albidus ssp. *albidus* (Metcalf Canyon jewelflower) was first collected in 1887 by Volney Rattan, a botany teacher and author of an early California flora, from hillsides a few miles south of San Jose. Edward Greene described *S. albidus* ssp. *albidus* in 1887 (Greene 1887); later he redefined the limits of *Euclisia*, formerly a subgenus of *Streptanthus*, treating it as a genus in its own right (Greene 1904). *S. albidus* ssp. *albidus*, as a member of the *Euclisia* group, was included in this change. Jepson (1925) returned *Euclisia* to subsection status, and later authors followed his treatment. Jepson (1925) also treated *S. albidus* ssp. *albidus* as a subspecies of *S. glandulosus*. Kruckeberg published a revision of the *Streptanthus glandulosus* complex in which he recognized the close relationships among *S. glandulosus*, *S. albidus*, and *S. niger* (Kruckeberg 1958). In this paper he notes that the "sharp genetic discontinuity between *S. albidus* and all other populations, coupled with the morphological distinctness and regional restriction of *S. albidus* warrant the restoration of this Greeneian species." He recognized two subspecies: *S. albidus* ssp. *albidus* and *S. albidus* ssp. *peramoenus* (Kruckeberg 1958).

Streptanthus albidus ssp. *albidus* is an annual herb of the mustard family (Brassicaceae) that reaches up to 1 m (3 ft) in height. It has bristly hairs at the base, and pale green, strongly glaucous stem and leaves. The flowers are borne in leafless terminal racemes. The upper three of the white to yellow to whitish-green sepals are fused, with the lower (fourth) sepal free and spreading. The four petals, 8-11 mm (.3-.4 in) long, are whitish with light purple veins. The erect flattened pods are 3-8 cm (1-3 in) long. The only *Streptanthus* species likely to co-occur with *S. albidus* ssp. *albidus* is its close relative *Streptanthus albidus* ssp. *peramoenus*. *S. albidus* ssp. *peramoenus* is distinguished by its dark purple sepals.

Streptanthus albidus ssp. *albidus* has always been rare. It is endemic to serpentine outcrops with little soil development. It can be locally abundant, but its range is limited, extending less than 30 km (20 miles) from San Jose south to Anderson Lake, which lies northeast of Morgan Hill. Furthermore, the serpentine outcrops on which *S. albidus* ssp. *albidus* occurs are patchily distributed and comprise only a small percentage of the area within its range. Nine populations and a total of 20,000-25,000 plants have been recorded (McCarten 1992b). The plant is

threatened by urbanization and off-road vehicles.

Previous Federal Action

Federal government actions on the 12 plants began as a result of section 12 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.), which directed the Secretary of the Smithsonian Institution to prepare a report on those plants considered to be endangered, threatened, or extinct in the United States. This report, designated as House Document No. 94-51, was presented to Congress on January 9, 1975, and included *Cordylanthus tenuis* ssp. *capillaris* (listed as *Cordylanthus brunneus* ssp. *capillaris*), *Calochortus tiburonensis*, *Ceanothus ferrisae*, *Cirsium fontinale* var. *fontinale*, *Clarkia franciscana*, *Hesperolinon congestum*, *Streptanthus albidus* ssp. *albidus*, and *Streptanthus niger* as endangered species and *Castilleja neglecta* and *Eriophyllum latilobum* as threatened taxa. The Service published a notice in the July 1, 1975, Federal Register (40 FR 27823) of its acceptance of the report of the Smithsonian Institution as a petition within the context of section 4(c)(2) (petition provisions are now found in section 4(b)(3) of the Act) and its intention thereby to review the status of the plant taxa named therein. The above 10 taxa were included in the July 1, 1975, notice. As a result of that review, on July 16, 1976, the Service published a proposal in the Federal Register (41 FR 24523) to determine approximately 1,700 vascular plant species to be endangered species pursuant to section 4 of the Act. The list of 1,700 plant taxa was assembled on the basis of comments and data received by the Smithsonian Institution and the Service in response to House Document No. 94-51 and the July 1, 1975, Federal Register publication. *Calochortus tiburonensis*, *Ceanothus ferrisae*, *Cirsium fontinale* var. *fontinale*, *Clarkia franciscana*, *Cordylanthus tenuis* ssp. *capillaris* (listed as *Cordylanthus brunneus* ssp. *capillaris*), *Hesperolinon congestum*, *Streptanthus albidus* ssp. *albidus*, and *Streptanthus niger* were included in the June 16, 1976, Federal Register document.

General comments received in response to the 1976 proposal were summarized in an April 26, 1978, Federal Register publication (43 FR 17909). The Endangered Species Act Amendments of 1978 required that all proposals over 2 years old be withdrawn. A 1-year grace period was given to those proposals already more than 2 years old. In the December 10, 1979, Federal Register (44 FR 70796), the Service published a notice of

withdrawal of the June 16, 1976, proposal, along with four other proposals that had expired.

The Service published an updated notice of review for plants on December 15, 1980 (45 FR 82480). This notice included *Calochortus tiburonensis*, *Castilleja neglecta*, *Ceanothus ferrisae*, *Cirsium fontinale* var. *fontinale*, *Clarkia franciscana*, *Cordylanthus tenuis* ssp. *capillaris*, *Hesperolinon congestum*, *Pentachaeta bellidiflora*, *Streptanthus albidus* ssp. *albidus*, and *Streptanthus niger* as category 1 candidates for Federal listing, and *Eriophyllum latilobum* as a category 2 candidate. Category 1 taxa are those for which the Service has on file substantial information on biological vulnerability and threats to support preparation of listing proposals. Category 2 taxa are those for which data in the Service's possession indicate listing is possibly appropriate, but for which substantial data on biological vulnerability and threats are not currently known or on file to support proposed rules. On November 28, 1983, the Service published in the Federal Register a supplement to the Notice of Review (48 FR 39526). This supplement changed *Ceanothus ferrisae*, *Cirsium fontinale* var. *fontinale*, *Pentachaeta bellidiflora*, and *Streptanthus albidus* ssp. *albidus* from category 1 to category 2 candidates.

The plant notice was again revised on September 27, 1985 (50 FR 39526). *Calochortus tiburonensis*, *Castilleja neglecta*, *Clarkia franciscana*, *Eriophyllum latilobum*, *Hesperolinon congestum*, and *Streptanthus niger* were included as category 1 candidates; *Ceanothus ferrisae*, *Cirsium fontinale* var. *fontinale*, *Cordylanthus tenuis* ssp. *capillaris*, *Pentachaeta bellidiflora*, and *Streptanthus albidus* ssp. *albidus* were included as category 2 candidates. Another revision of the plant notice was published on February 21, 1990 (55 FR 6184). In this revision, *Castilleja neglecta*, *Ceanothus ferrisae*, *Cirsium fontinale* var. *fontinale*, *Clarkia franciscana*, *Cordylanthus tenuis* ssp. *capillaris*, *Dudleya setchellii*, *Eriophyllum latilobum*, *Hesperolinon congestum*, *Streptanthus albidus* ssp. *albidus*, and *Streptanthus niger* were included as category 1 candidates; *Calochortus tiburonensis* and *Pentachaeta bellidiflora* were included as category 2 candidates. Since the publication of that notice, additional information was received on *Pentachaeta bellidiflora* that elevated it to category 1 status. The Service also re-evaluated the information available for *Calochortus tiburonensis* and elevated it to category 1 status. The Service

therefore believes that sufficient information is now available to support the proposed listing of these two species.

Section 4(b)(3)(B) of the Endangered Species Act, as amended in 1982, requires the Secretary to make certain findings on pending petitions within 12 months of their receipt. Section 2(b)(1) of the 1982 Amendments further requires that all petitions pending on October 13, 1982, be treated as having been newly submitted on that date. This was the case for *Calochortus tiburonensis*, *Ceanothus ferrisae*, *Cirsium fontinale* var. *fontinale*, *Clarkia franciscana*, *Cordylanthus tenuis* ssp. *capillaris*, *Hesperolinon congestum*, *Streptanthus albidus* ssp. *albidus*, *Streptanthus niger*, *Castilleja neglecta*, and *Eriophyllum latilobum*, because the 1975 Smithsonian report had been accepted as a petition. On October 13, 1982, the Service found that the petitioned listing of these species was warranted, but precluded by other pending listing actions, in accordance with section 4(b)(3)(B)(iii) of the Act; notification of this finding was published on January 20, 1984 (49 FR 2485). Such a finding requires the petition to be recycled, pursuant to section 4(b)(3)(c)(i) of the Act. The finding was reviewed in October of 1984, 1985, 1986, 1987, 1988, 1989, 1990, and 1991. Publication of this proposal constitutes the final finding for the petitioned action. There are no pending petitions for *Pentachaeta bellidiflora* or *Dudleya setechellii*.

Summary of Factors Affecting the Species

Section 4 of the Endangered Species Act (Act) and regulations (50 CFR part 424) promulgated to implement the listing provisions of the Act set forth the procedures for adding species to the Federal lists of threatened and endangered species. A species may be determined to be an endangered or threatened species due to one or more of the five factors described in section 4(a)(1). These factors and their application to *Calochortus tiburonensis* Hill (Tiburon mariposa lily), *Castilleja neglecta* Zeile (Tiburon paintbrush), *Ceanothus ferrisae* McMinn (coyote ceanothus), *Cirsium fontinale* Jeps. var. *fontinale* (fountain thistle), *Clarkia franciscana* Lewis and Raven (Presidio clarkia), *Cordylanthus tenuis* Gray ssp. *capillaris* (Penn.) Chuang and Heck. (Pennell's bird's beak), *Dudleya setechellii* (Santa Clara Valley dudleya), *Eriophyllum latilobum* Rydb. (San Mateo woolly sunflower), *Hesperolinon congestum* (A. Gray) Small (Marin dwarf-flax), *Pentachaeta bellidiflora*

Greene (white-rayed pentachaeta), *Streptanthus albidus* Greene ssp. *albidus* (Metcalf Canyon jewelflower), and *Streptanthus niger* Greene (Tiburon jewelflower) are as follows:

A. The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range

The destruction of habitat through residential or recreational development is the greatest threat faced by these species. The plants are limited to serpentine soils. Serpentine outcrops in the San Francisco Bay area are limited; 20 percent of those outcrops have already been eliminated as plant habitat due to development (McCarten 1987b). The pressure to build more houses, roads, and other facilities for humans is great in all the counties under consideration. Serpentine habitats also have been fragmented by the construction of roads such as Interstate 280. Habitat fragmentation increases the risks of extinction due to chance events such as fire, flood, landslide, pest or disease outbreaks, severe drought, or other natural or human-caused disaster.

Cordylanthus tenuis ssp. *capillaris* has never been known from more than the two populations that occur today. Ownership of the type locality is mixed; part of the population occurs on the Harrison Grade Preserve, which is owned and managed by the California Department of Fish and Game. Habitat on the preserve is threatened by unauthorized activities such as off-road vehicle use. Plants on private parcels are threatened with potential development.

The second population of *Cordylanthus tenuis* ssp. *capillaris* occurs on private property a few miles to the west of the type locality. Plans for residential development of this site are currently under review at the Sonoma County Planning Department (Betty Guggolz, pers. comm. 1992). The owner of this property has been working with the California Department of Fish and Game to minimize impacts to the *Cordylanthus tenuis* ssp. *capillaris* (Ann Howald, California Department of Fish and Game, pers. comm., 1992). Plans include the donation of over 40 hectares (ha) (100 acres), including *C. tenuis* ssp. *capillaris* habitat, to the county for use as a park (Betty Guggolz, pers. comm., 1992). This donation may afford protection to part of the second population of *C. tenuis* ssp. *capillaris*, but since the transfer has not yet taken place and no plans have been made for protection of the plant on this new park, the population still should be considered threatened by development.

Calochortus tiburonensis is at present protected from development because the land on which it occurs is owned and managed by The Nature Conservancy, a group whose management goals are the maintenance of biodiversity and the protection of rare and endangered species (Larry Serpa, pers. comm., 1992). The preserve is fenced to reduce the incidence of off-road vehicle use, but the site is still accessible to bicycles, motorbikes, and pedestrians, and it is not patrolled. The proximity of the preserve to residential areas renders it vulnerable to overuse and vandalism. Furthermore, this preserve, being on The Nature Conservancy's list of potential divestitures, will transfer ownership when a suitable organization is found to manage it (Larry Serpa, pers. comm., 1992).

Castilleja neglecta has never been widespread. Three of the five populations occur on the Tiburon Peninsula in Marin County, and one occurs in Napa County. A recently discovered population on the Golden Gate National Recreation Area extends the known range to western Marin County. Each of the three occurrences on the Tiburon Peninsula has multiple landowners. The Nature Conservancy owns over half of the Ring Mountain occurrence and the town of Tiburon owns portions of the occurrence in the Middle Ridge area of the peninsula. The remainder of each of these occurrences is privately-owned. The third occurrence on the peninsula is on private property near St. Hilary's Church in Tiburon. Development on the Tiburon Peninsula is extensive and rapid; over 60 percent of *C. neglecta* habitat has already been destroyed by development (Hunter 1989a). Residential development is ongoing on several parcels of the Middle Ridge occurrence, and proposed for both parcels at the St. Hilary's occurrence. The habitat at both of these sites is also threatened by pedestrian traffic. The plants on Ring Mountain Preserve are protected from development but are threatened by sliding of the slope on which they occur. The toe of the slope was removed to accommodate residential development in the 1960s. Soil material that slides into the street at the base of the slope is removed by the City of Corte Madera, and the slope continues to slump. Managers from The Nature Conservancy estimate that approximately one-third of the population is at risk (Lynn Lozier, pers. comm., 1992). The Napa County population occurs on private property near a gravel quarry. Although quarry expansion plans that would result in the

destruction of more than 80 percent of the population are no longer being actively pursued, the potential for expansion still exists.

Streptanthus niger is an extremely narrowly-distributed species; its entire range amounts to less than one-third of a square mile. Urban development has destroyed over 40 percent of potential *S. niger* habitat (Hunter 1989b). Both of the two known occurrences have multiple landowners. The town of Tiburon owns portions of the occurrence on the Middle Ridge of the peninsula, and the occurrence at St. Hilary's Church in Tiburon is owned in part by the Tiburon Landmark Society. The remainder of each of these two occurrences is privately-owned. Residential development is ongoing at several parcels of the Middle Ridge occurrence, and proposed for both parcels of the St. Hilary's occurrence. Habitat at both of these sites is also threatened by pedestrian traffic.

Clarkia franciscana was once thought to be restricted to the Presidio in San Francisco County, but about 10 years ago a population was discovered in Alameda County in the Oakland hills. The two populations in San Francisco County occur at the Presidio, currently owned by the U.S. Department of Defense. These populations are threatened by habitat degradation. The Army has plans to fence rare plant habitat on the Presidio; at present, however, pedestrian and mountain bicycle traffic on and near casually established "social trails" threatens the habitat. Ownership of the Presidio is expected to be transferred from the Army to the National Park Service within a year. The Presidio represents a significant natural and cultural resource within San Francisco city limits, and is expected to be widely promoted by the Park Service and heavily used by visitors (Terri Thomas, Golden Gate National Recreation Area, pers. comm., 1992). The increase in visitation after transfer to the Park Service will increase the negative impact of traffic on *C. franciscana*.

The three populations of *Clarkia franciscana* in Alameda County are all threatened by alien species (see Factor E). The smallest of the three, consisting of 30 plants (Olson 1991c) occurs on an undeveloped site that bears a sign offering custom-built homes.

One occurrence of *Cirsium fontinale* var. *fontinale* has been reported from Santa Clara County, but the site is thought to have been destroyed by urbanization (Niehaus 1977). The three remaining populations grow in San Mateo County. The largest population occurs to the east of Crystal Springs

Reservoir and north of State Highway 92, along both sides of Interstate 280. It occurs partly on San Francisco Water Department land and partly on a California Department of Transportation right-of-way. Given its proximity to the roadside, it is likely to be affected by any highway projects in the area. Major realignments of Highway 92 were planned several years ago, but the plans have been abandoned due to lack of funding (Richard Vonarb, California Department of Transportation, pers. comm., 1992). They could be revived, however, if funding should become available. At present, a smaller project to widen Highway 92 east of the reservoir causeway is under review. Provision for the removal of water from the increased road surface may adversely affect some of the plants. The California Department of Transportation is aware of the plant locations and vulnerability. The proposed construction of multi-use recreational trails on San Francisco Water Department land presents an additional threat. Trail construction would threaten the plants through direct destruction of the habitat or through modification of hydrologic regimes. Because *C. fontinale* var. *fontinale* is dependent upon seeps and springs to provide abundant soil moisture, any disruption in the flow of water (such as that caused by road, trail, or drain construction) would threaten the plants.

A second and substantially smaller population of *Cirsium fontinale* var. *fontinale* occurs in the "Triangle" west of Interstate 280. One to two hundred plants have been observed on San Francisco Water Department lands; an outlying colony of about 25 plants occurs on an easement held by the California Department of Transportation. This colony occupies a smaller territory in 1992 than it has in previous years (Susan Sommers, pers. comm., 1992). The plants on Water Department land are threatened by proposed trail construction, as discussed for *Hesperolinon congestum*. In addition, a general management plan for the Water Department lands currently is being developed (Ed Stewart, San Francisco Water Department, pers. comm., 1992), which may include the possibility of golf course construction at the Triangle.

The single specimen of *Cirsium fontinale* var. *fontinale* in Edgewood County Park occurs in a drainage ditch beside a trail. Clearing of the ditch to improve or maintain drainage could damage or destroy this plant or any seedlings it may produce.

Eriophyllum latilobum has been reported from only two locations, one of

which is likely erroneous (specimen misidentified, according to Barry Prigge, pers. comm., 1992). The single remaining population consists of about 300 plants that occur along 4 km (2.5 miles) of Crystal Springs Road in San Mateo County. Seventy-five percent of the plants occur within 9 m (30 ft) of the road, where land ownership is poorly defined (McGuire 1992). The City of Hillsborough, the County of San Mateo, and the San Francisco Water Department have varying jurisdictions over the land. The steep slopes along Crystal Springs Road provide a very unstable habitat for *E. latilobum*. The slopes are subject to erosion and soil slippage. After soil slippage occurs, road maintenance crews remove the slumped soil, which may contain mature individuals, seedlings, and/or seeds of the *E. latilobum*. The road cut is then reshaped, which may damage plants remaining on the banks. The proposed construction of the San Mateo Creek Trail (McGuire and Morey 1992) would have adverse impacts on the plant if trail design does not incorporate plant conservation. The paved trail, which is 3 m (10 ft) wide, is expected to run adjacent to Crystal Springs Road from Skyline Boulevard to the San Mateo City boundary. Construction of the trail could damage or eliminate colonies of *E. latilobum*, alter site hydrology, accelerate soil erosion through increased pedestrian and bicycle traffic, and allow for the introduction of aggressive alien plant species.

Fourteen populations of *Hesperolinon congestum* still exist. One Marin County population is protected at The Nature Conservancy's Ring Mountain Preserve. Two relatively small populations occur on land owned by the Marin Municipal Water District. Another small population is found in the Golden Gate National Recreation Area above Nicasio Reservoir. A fifth population occurs in part on a small preserve at St. Hilary's Church, and in part on private land which recently has been proposed for development (Robison and Morey 1992a). The sixth Marin County site is the Middle Ridge area of the Tiburon Peninsula, on which occur a few scattered groups of plants. Some plants grow on land designated as open space by the city of Tiburon. The remainder of the plants occur on private land and are threatened by ongoing or proposed residential development.

One population of *Hesperolinon congestum* is known from San Francisco County. This occurrence is threatened by foot traffic.

In San Mateo County, three populations of *Hesperolinon congestum* are known to occur on private property.

These plants are threatened by proposed development and by the consequences of recently completed development, such as trampling, trash dumping, and changes in hydrology caused by irrigation runoff (Robison and Morey 1992a). Two populations occur on land owned by the San Francisco Water Department. Their habitat is threatened by the proposed construction of trails in the watershed. The construction of these trails and the accompanying fences may damage *Hesperolinon congestum* habitat. Two populations occur at Edgewood County Park and have been threatened by the proposed construction of a golf course at the park. On May 5, 1992, the county board of supervisors voted to declare Edgewood County Park a natural preserve. This designation will provide guidance to park personnel in determining uses of the park, but it has no enforcement provisions, and can be revoked by a vote of the board of supervisors.

Pentachaeta bellidiflora historically ranged from Marin County to Santa Cruz County. Three populations in Marin County and two in San Mateo County were destroyed by urbanization. One Marin County occurrence was destroyed by off-road vehicles. Two sites in Santa Cruz County no longer support *P. bellidiflora* (Robison and Morey 1992b). The single remaining population of *P. bellidiflora* was bisected by the construction of California Interstate 280 in the late 1960s. The largest portion of the population occurs in the Triangle, on land administered by the San Francisco Water Department. A small remnant of this population is located to the east of Interstate 280, on Edgewood County Park. The proposed construction of trails on Water Department land threatens the *P. bellidiflora* habitat.

Ceanothus ferrisiae is known from three populations in Santa Clara County. The largest population, consisting of approximately 5,000 plants, occurs near Anderson Dam, partially on Santa Clara County Park property and partially on private property. The county proposes further recreational development in the park, which could threaten the *Ceanothus ferrisiae* (Chris Nagano, U.S. Fish and Wildlife Service, pers. comm., 1992). An outlying population occurs 3 km (2 miles) west on land leased and managed by a waste management firm. Waste Management, Inc. and The Nature Conservancy jointly funded research on *C. ferrisiae*, which was conducted by the Center for Conservation Biology. Researchers have found that *C. ferrisiae* is relatively easy to propagate from seed, and both Waste Management and the Santa Clara Valley Water District have

been experimenting with the use of *C. ferrisiae* for revegetation projects. The third population, consisting of approximately 500 plants (Corelli 1989) occurs on private land scheduled for development.

Dudleya setchellii always has been restricted to the Coyote Valley area of Santa Clara County. Eleven of the 14 populations are on private land and are subject to various levels of threat due to development. The three northernmost populations, which occur in southeastern San Jose, and the three southernmost populations, which occur in the area around Morgan Hill, are at greatest risk. These areas are developing especially rapidly, and all six sites have been proposed for development at one time or another. Two of the central populations also are threatened with imminent development, including residential development and road construction. One central population, due to its proximity to an off-road motorcycle park, may be threatened by off-road motorcycle traffic and unauthorized dumping. The remaining two populations that occur on private land are on the grounds of the IBM Bailey Avenue laboratory. The company apparently plans to preserve the habitat (McCarten 1992a). Three populations occur on land owned by Santa Clara County. Of these, two populations occur in county parks. The final population occurs on county-owned land that is slated for the construction of a jail and an animal shelter. The county intends to avoid the *D. setchellii* habitat during construction (Kathy Freas, CH2M Hill, pers. comm., 1992), but specific plans have not yet been developed.

The known historical distribution of *Streptanthus albidus* ssp. *albidus* is as restricted as its current distribution. It is found only in the Coyote Valley area of Santa Clara Valley, primarily on the east side of the valley. Of the 13 documented sites, 9 are known to still harbor plants. Two populations are known to have been extirpated, one by the construction of Anderson Dam, and the other as a result of being covered by fill from a housing development. Two occurrences are known from herbarium records only. One of these historical sites was revisited in 1990, but no plants were found. *Streptanthus albidus* ssp. *albidus* was last observed at the other historical site in 1895. The remaining nine populations are threatened by impending or potential development. Two of these populations occur on county property on which the construction of a jail and an animal shelter is proposed. The county intends to avoid the *Streptanthus* habitat during construction (Kathy Freas, pers. comm.,

1992) but specific plans have not yet been developed.

B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Overutilization is not currently known to be a factor for any of the 12 plants, but unrestricted collecting for scientific or horticultural purposes or excessive visits by individuals interested in seeing rare plants could result from increased publicity as a result of this proposal. *Calochortus tiburonensis* is a strikingly unusual member of a much-collected genus. *Eriophyllum latilobum*, with its showy golden flowers and proximity to roads and the proposed San Mateo Creek trail, might prove to be especially tempting to collectors. *Dudleya setchellii* is also vulnerable because of the horticultural appeal of succulents and the slow growth of the plants. The remaining plants are usually not spectacular in flower, but may nonetheless appeal to collectors because of their rarity.

C. Disease or Predation

Both horses and deer have been reported to browse on *Cordylanthus tenuis* ssp. *capillaris*, but the number of plants damaged generally appears to be minimal (Lynn Lozier, pers. comm., 1992). Cattle grazing has been reported to threaten the western Marin population of *Castilleja neglecta* (Martin 1991) and a portion of the American Canyon occurrence (Hunter 1989a). Another source suggests, however, that cattle provide little threat to the American Canyon population because the plants occur on a very steep slope (Jake Ruygt, Napa Valley Chapter, California Native Plant Society, pers. comm., 1992).

Seed predation by beetle larvae has been reported for *Cirsium fontinale* var. *fontinale* (Dean Kelch, University of California, Davis, pers. comm., 1992); however, the extent of the impact of this seed predation on *C. fontinale* var. *fontinale* is unknown. Beetle larvae also have been observed in seed heads of *Eriophyllum latilobum* (McGuire and Morey 1992).

D. The Inadequacy of Existing Regulatory Mechanisms

Under the Native Plant Protection Act (Division 2, Chapter 10 section 1900 et seq. of the Fish and Game Code) and California Endangered Species (Division 3, Chapter 1.5 section 2050 et seq.), the California Fish and Game Commission has listed three of these species (*Cirsium fontinale* var. *fontinale*, *Clarkia franciscana*, and *Streptanthus niger*) as endangered, two species (*Calochortus*

tiburonensis and *Castilleja neglecta*) as threatened, and one species (*Cordylanthus tenuis* ssp. *capillaris*) as rare. The California Fish and Game Commission recently voted to list two other species (*Eriophyllum latilobum* and *Pentachaeta bellidiflora*) as endangered, and one species (*Hesperolinon congestum*) as threatened. Although both statutes prohibit the "take" of State-listed plants (Chapter 1.5 section 1908 and Chapter 10 section 2080), State law appears to exempt the taking of such plants via habitat modification or land use change by the landowner. After the California Department of Fish and Game notifies a landowner that a State-listed plant grows on his or her property, State law requires only that the landowner notify the agency "at least ten days in advance of changing the land use to allow salvage of such plant." (Chapter 1.5 section 1913).

The California Environmental Quality Act (CEQA) requires a full public disclosure of the potential environmental impacts of proposed projects. The public agency with primary authority or jurisdiction over the project is designated as the lead agency, and is responsible for conducting a review of the project and consulting with other agencies concerned with resources affected by the project. Section 15065 of the CEQA Guidelines requires a finding of significance if a project has the potential to "reduce the number or restrict the range of a rare or endangered plant or animal." Species that are eligible for listing as rare, threatened, or endangered but are not so listed are given the same protection as those species that are officially listed with the State. Once significant effects are identified, the lead agency has the option to require mitigation for effects through changes in the project or to decide that overriding considerations make mitigation infeasible. In the latter case, projects may be approved that cause significant environmental damage, such as destruction of endangered species or their habitat. The protection of threatened and endangered species through CEQA is therefore dependent upon the good will of the lead agency involved, and in practice statements of overriding considerations are commonly prepared.

Three of the plants occur at Edgewood County Park in San Mateo County, which has recently been designated as a natural preserve. This designation is intended to encourage management for environmental protection, but it can be revoked by a vote of the county board of supervisors, and therefore does not

provide dependable long-term protection for the plants.

Section 404 of the Clean Water Act regulates the placement of dredge and fill materials into waters of the United States (including small acreages above the headwaters of streams). Under section 404, nationwide permits, which undergo minimal public and agency review, can be issued for projects involving less than 10 acres of waters of the United States and adjacent wetlands, unless a listed species may be adversely affected. Individual permits, which are subject to more extensive review, are required for projects that affect greater than 10 acres.

The U.S. Army Corps of Engineers (Corps) is the agency responsible for administering the section 404 programs. The Service, as part of the section 404 review process, provides comments on both pre-discharge notices for nationwide permits and public notices for individual permits. The Service's comments are only advisory, although procedures exist for elevation when disagreements between the agencies arise. In practice, the Corps' actions under section 404 would not adequately protect *Cirsium fontinale* var. *fontinale*, which occurs in riparian serpentine seep areas.

Most projects within the range of *Cirsium fontinale* var. *fontinale* considered in this proposal may require approval from the Corps as currently described in section 404 of the Clean Water Act. Federal listing of this species would ensure greater consideration of the effects of permitted actions during the review process as well as provide the protections of section 7 of the Act.

E. Other Natural of Manmade Factors Affecting its Continued Existence

As discussed in the "Background" section, the large and still increasing numbers of people in the San Francisco Bay area place a great strain on undeveloped wildlands, through activities such as pedestrian and off-road vehicle traffic and unauthorized garbage dumping. Disturbance may directly impact plants; more seriously, it can increase erosion and allow the invasion of alien species such as the many introduced annual grasses common in California. Competition with introduced species is a serious threat to serpentine natives (McCarten, 1987b).

Cordylanthus tenuis ssp. *capillaris* growing along roadsides is threatened by roadside maintenance such as mowing and spraying (Lynn Lozier, pers. comm., 1992). Vehicular traffic threatens plants in and near the parking area at the Harrison Grade Reserve,

which is poorly defined and close to the plant population (McCarten 1987a). Unauthorized dumping of large items such as bottles, furniture, appliances, and cut wood is also a threat. Light disturbance at the Harrison Grade Reserve such as infrequent grading of dirt roads appears to increase the number of *C. tenuis* ssp. *capillaris* (Lynn Lozier, The Nature Conservancy, pers. comm., 1992), but higher levels of disturbance may facilitate the invasion of alien species (McCarten 1987a) and result in a decline of *C. tenuis* ssp. *capillaris*.

Calochortus tiburonensis is threatened, by virtue of its occurrence in a single population, with chance events such as fire, severe drought, pest or disease outbreak, landslides, or other natural or human-caused disasters. The proximity of the plant to a large human population increases the likelihood that human-caused disasters or acts of vandalism will affect the plants or their habitat.

Clarkia franciscana is threatened by road maintenance (mowing) at the Presidio. Mowing of grasslands before the *Clarkia franciscana* has set seed also threatens the populations. Populations at the Presidio also are threatened by the encroachment of alien plant species, including *Senecio mikanoides* (German ivy), *Carpobrotus* sp. (iceplant), *Rubus* spp. (blackberries), and by natives planted outside their natural range, such as *Pinus radiata* (Monterey pine) (California Department of Fish and Game 1988). The population size at the type locality increased following removal of alien plant species in the late 1980s. Constant vigilance and effort is needed to prevent reinvasion.

At latest report the largest population of *Clarkia franciscana*, occurring at Redwood Regional Park in Alameda County, consisted of 4,000–5,000 plants (Gottlieb and Edwards 1992, Olson 1991a). The East Bay Regional Park District is aware of the *Clarkia franciscana* population and has been taking it into account in their management plans (Ray Budzinski, East Bay Regional Park District, pers. comm., 1992). The habitat is threatened by competition with annual grasses (Ray Budzinski, pers. comm., 1992) and other alien plants, including *Cortaderia seloana* (pampas grass) and *Cytisus monspessulanus* (French broom) (Olson 1991a). The two smaller populations in Alameda County, consisting of 200 plants (Olson 1991b) and 30 plants (Olson 1991c) respectively, are also threatened by alien species *Cytisus monspessulanus* and *Cortaderia jubatum*. The larger of the two occurs on a roadcut.

The Crystal Springs Reservoir population of *Cirsium fontinale* var. *fontinale* is threatened by several factors, including roadside maintenance. The California Department of Transportation is aware of the rare plants in this area, and the maintenance division submits spraying plans for internal environmental review before spraying in the area where plants are known to occur (Richard Vonarb, pers. comm., 1992). Alien plants such as *Cortaderia selloana* have established themselves near the *C. fontinale* var. *fontinale*, and threaten several subpopulations (Zoe Chandik, pers. comm., 1992). Dumping of garden debris from households on the ridge above the plants covers plants and renders the habitat unsuitable for plant establishment and growth. It has been suggested that *C. fontinale* var. *fontinale* may be threatened with hybridization with *Cirsium quercetorum*, but only one hybrid has been collected in recent years, so this is not thought to be a serious problem (Dean Kelch, pers. comm., 1992).

Eriophyllum latilobum is threatened by many factors. Dumping of garden debris and downhill seepage of pesticides from homeowners living above the population may have negative impacts on *E. latilobum* habitat. The plant also is threatened by competition with alien plants; its habitat is more densely populated with *Carduus* sp. and *Bromus* sp. than it was 10 years ago (John Mooring, pers. comm., 1992). Road maintenance also threatens *E. latilobum*. Preemergent herbicide is commonly used along the side of the road; drift from herbicide spray may damage those plants close to the road. San Mateo County road maintenance crews were alerted to the existence of *E. latilobum* in 1990, and instructed to avoid the plants by the San Mateo County Planning Department; however, road maintenance activities are not monitored to ensure protection (Roman Gankin, San Mateo County Planning Division, pers. comm. to Teri McGuire, Botanist, California Department of Fish and Game, cited in McGuire and Morey 1992). *E. latilobum* is not a vigorous reproducer; low germination rates and low seedling survival have been observed under greenhouse conditions (John Mooring, in litt., 1992, in McGuire and Morey 1992).

Hesperolinon congestum is threatened by the encroachment of native shrubs in San Francisco County. In San Mateo County all three populations are threatened by trash dumping as a consequence of recently completed development.

Pentachaeta bellidiflora is potentially threatened by competition from alien plant species; this competition becomes a problem when the soils are disturbed (Robison and Morey 1992b).

Ceanothus ferrisiae is threatened by unauthorized dumping of litter and larger debris at the Anderson dam site.

Streptanthus albidus ssp. *albidus* is threatened by dumping and off-road motorcycle use. Road maintenance or construction threaten populations that occur on roadcuts. Grazing threatens some other populations.

The Service has carefully assessed the best scientific and commercial information available regarding the past, present, and future threats faced by these species in determining to propose this rule. These 12 plants are endemic to a very specific habitat that occurs in scattered outcrops. The rapid urban development in the San Francisco Bay region offers the greatest threat to these plants. They are threatened further by the invasion of alien species, roadside maintenance, soil erosion and slipping, garbage dumping, livestock grazing, seed predation, and small population sizes that increase their vulnerability to chance events such as fire, flood, drought, pest and disease outbreaks, and other natural and human-caused disasters. Ten of the 12 are in danger of extinction throughout all or a part of their range, and the preferred action is therefore to list *Castilleja neglecta*, *Ceanothus ferrisiae*, *Cirsium fontinale* var. *fontinale*, *Clarkia franciscana*, *Cordylanthus tenuis* ssp. *capillaris*, *Dudleya setchellii*, *Eriophyllum latilobum*, *Pentachaeta bellidiflora*, *Streptanthus albidus* ssp. *albidus*, and *Streptanthus niger* as endangered. Two of the twelve are not now in immediate danger of extinction throughout all or a significant portion of their range. However, given the extremely limited distribution of *Calochortus tiburonensis*, and if appropriate management actions are not taken to protect *Hesperolinon congestum*, these two species are likely to become in danger of extinction in the near future. As a result, the preferred action is to list *Calochortus tiburonensis* and *Hesperolinon congestum* as threatened.

Critical Habitat

Section 4(a)(3) of the Act requires that, to the maximum extent prudent and determinable, the Secretary designate critical habitat concurrently with determining a species to be endangered or threatened. The Service finds that designation of critical habitat is not prudent for these species. Because the 12 plants face numerous anthropogenic threats (see Factors A

and E in "Summary of Factors Affecting the Species") and the 12 occur predominantly on private land, the publication of precise maps and descriptions of critical habitat in the Federal Register would make these plants more vulnerable to incidents of vandalism and, therefore, could contribute to the decline of these species and increase enforcement problems. The listing of these species as endangered or threatened also publicizes the rarity of these plants and, thus, can make these plants attractive to researchers or collectors of rare plants. The proper agencies have been notified of the locations and importance of protecting the habitat of these species. Protection of the habitat of these species will be addressed through the recovery process and through the section 7 jeopardy standard. Therefore, the Service finds that designation of critical habitat for these plants is not prudent at this time, because such designation likely would increase the degree of threat from vandalism, collecting, or other human activities.

Available Conservation Measures

Conservation measures provided to species listed as endangered or threatened under the Act include recognition, recovery actions, requirements for Federal protection, and prohibitions against certain activities. Recognition through listing encourages and results in conservation actions by Federal, State, and private agencies, groups, and individuals. The Act provides for possible land acquisition and cooperation with the State and requires that recovery actions be carried out for all listed species. Such actions are initiated by the Service following listing. The protection required of Federal agencies and the prohibitions against certain activities involving listed plants are discussed, in part, below.

Section 7(a) of the Act requires Federal agencies to evaluate their actions with respect to any species that is proposed or listed as endangered or threatened and with respect to its critical habitat, if any is being designated. Regulations implementing this interagency cooperation provision of the Act are codified at 50 CFR part 402. Section 7(a)(4) of the Act requires Federal agencies to confer with the Service on any action that is likely to jeopardize the continued existence of a proposed species or result in destruction or adverse modification of proposed critical habitat. If a species is listed subsequently, Section 7(a)(2) requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the

continued existence of such a species or to destroy or adversely modify its critical habitat. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency must enter into formal consultation with the Service.

Federal activities potentially affecting one or more of the 12 plants likely will involve recreation-related projects and perhaps grazing practices on Federal land. Populations of 3 of the 12 plants occur on Federal land. Two populations of *Hesperolinon congestum* and one of *Castilleja neglecta* occur on the golden Gate National Recreation Area. Two populations of *Clarkia franciscana* occur at the Presidio, on land now owned by the Department of Defense and soon to be transferred to the Golden Gate National Recreation Area.

The San Francisco Water Department owns 9,300 ha (23,000 acres) of land in San Mateo County. In 1969, a four-party agreement among the U.S. Department of the Interior, the State of California, San Mateo County, and the City and County of San Francisco established easements on the watershed lands to ensure that all future land use would be compatible with water quality criteria. These easements were granted to the U.S. Department of the Interior and are jointly administered by the San Francisco Water Department and the Golden Gate National Recreational Area. Populations of *Cirsium fontinale* var. *fontinale*, *Eriophyllum latilobum*, *Hesperolinon congestum* and *Pentachaeta bellidiflora* occur on Water Department land.

Hesperolinon congestum, *Pentachaeta bellidiflora*, *Dudleya setchellii*, and *Streptanthus albidus* ssp. *albidus* co-occur with the bay checkerspot butterfly (*Euphydryas editha bayensis*) in San Mateo or Santa Clara counties. The bay checkerspot is listed as a threatened species under the Endangered Species Act. Permits for incidental take of this species granted under section 10(a) of the Act may affect the plant species listed above. Preparation of Habitat Conservation Plans for the Bay checkerspot butterfly may therefore require internal section 7 consultation with regard to the four species listed above.

The 12 plants also may be affected by Federal mortgage programs, including the Veterans Administration and the U.S. Department of Housing and Urban Development (Federal Home Administration loans), or by construction of roads and highways by the Federal Highways Administration. At least one proposed project that may affect two of the plants also involves

wetlands under the jurisdiction of the U.S. Army Corps of Engineers.

Listing these 12 plants would provide for development of a recovery plan (or plans) for them. Such plan(s) would bring together both State and Federal efforts for conservation of the plants. The plan(s) would establish a framework for agencies to coordinate activities and cooperate with each other in conservation efforts. The plan(s) would set recovery priorities and estimate costs of various tasks necessary to accomplish them. They also would describe site-specific management actions necessary to achieve conservation and survival of the 12 serpentine plants.

The Act and its implementing regulations found at 50 CFR 17.61, 17.62, and 17.63 for endangered species and 17.71 and 17.72 for threatened species set forth a series of general prohibitions and exceptions that apply to all endangered or threatened plants. With respect to the 12 plants from San Francisco Bay area serpentine habitats, all trade prohibitions of section 9(a)(2) of the Act, implemented by 50 CFR 17.61 or 17.71, would apply. These prohibitions, in part, make it illegal for any person subject to the jurisdiction of the United States to import or export; transport in interstate or foreign commerce in the course of a commercial activity; sell or offer for sale in interstate or foreign commerce; remove and reduce to possession the species from areas under Federal jurisdiction; maliciously damage or destroy any such species on any area under Federal jurisdiction; or remove, cut, dig up, damage, or destroy any such endangered plant species on any other area in knowing violation of any State law or regulation or in the course of any violation of a State criminal trespass law. Certain exceptions apply to agents of the Service and State conservation agencies. The Act and 50 CFR 17.62, 17.63, and 17.72 also provide for the issuance of permits to carry out otherwise prohibited activities involving endangered or threatened plant species under certain circumstances. The Service anticipates few trade permits would ever be sought or issued for the 12 species because the plants are not common in cultivation or in the wild. Requests for copies of the regulations on listed plants and inquiries regarding them may be addressed to the Office of Management Authority, U.S. Fish and Wildlife Service, 4401 North Fairfax Drive, room 432, Arlington, Virginia 22203-3507 (703/358-2104).

Public Comments Solicited

The Service intends that any final action resulting from this proposal will be as accurate and as effective as possible. Therefore, comments or suggestions from the public, other concerned governmental agencies, the scientific community, industry, or any other interested party concerning this proposed rule are hereby solicited. Comments particularly are sought concerning:

- (1) Biological, commercial trade, or other relevant data concerning any threat (or lack thereof) to *Cordylanthus tenuis* ssp. *capillaris*, *Calochortus tiburonensis*, *Castilleja neglecta*, *Streptanthus niger*, *Clarkia franciscana*, *Cirsium fontinale* var. *fontinale*, *Eriophyllum latilobum*, *Hesperolinon congestum*, *Pentachaeta bellidiflora*, *Ceanothus ferrisae*, *Dudleya setchellii*, or *Streptanthus albidus* ssp. *albidus*;
- (2) The location of any additional populations of these species and the reasons why any habitat should or should not be determined to be critical habitat as provided by section 4 of the Act;
- (3) Additional information concerning the range, distribution, and population size of these species; and
- (4) Current or planned activities in the subject area and their possible impacts on these species.

Any final decision on this proposal will take into consideration the comments and any additional information received by the Service, and such communications may lead to a final regulation that differs from this proposal.

The Act provides for a public hearing on this proposal, if requested. Requests must be received within 45 days of the date of publication of the proposal. Such requests must be made in writing and addressed to the Field Supervisor of the Sacramento Field Office (see ADDRESSES section).

National Environmental Policy Act

The Fish and Wildlife Service has determined that an Environmental Assessment, as defined under the authority of the National Environmental Policy Act of 1969, need not be prepared in connection with regulations adopted pursuant to section 4(a) of the Act. A notice outlining the Service's reasons for this determination was published in the Federal Register on October 25, 1983 (48 FR 49244).

References Cited

A complete list of all references cited herein is available upon request from the Field Supervisor, Sacramento Field Office (see ADDRESSES section).

Author

The primary author of this proposed rule is Jeanine L. Hardison, U.S. Fish and Wildlife Service, Sacramento Field Office (see ADDRESSES section).

List of Subjects in 50 CFR Part 17

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, and Transportation.

Proposed Regulation Promulgation

PART 17—[AMENDED]

Accordingly, it is hereby proposed to amend part 17 subchapter B of Chapter I, title 50 of the Code of Federal Regulations, as set forth below:

1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361–1407; 16 U.S.C. 1531–1544; 16 U.S.C. 4201–4245; Pub. L. 99–625, 100 Stat. 3500, unless otherwise noted.

2. It is proposed to amend § 17.12(h) by adding the following, in alphabetical order under the families indicated, and by adding a new family "Linaceae—Flax family," in alphabetical order, to the List of Endangered and Threatened Plants:

§ 17.12 Endangered and threatened plants.

• • • • •

(h) • • •

Species		Historic range	Status	When listed	Critical habi- tat	Special rules
Scientific name	Common name					
Asteraceae—Aster family:						
<i>Cirsium fontinale</i> _____ var. <i>fontinale</i>	Fountain thistle _____	U.S.A. (CA) _____	E _____	_____	NA _____	NA _____
<i>Eriophyllum latilobum</i> _____	San Mateo woolly sunflower _____	U.S.A. (CA) _____	E _____	_____	NA _____	NA _____
<i>Pentachaeta belidiflora</i> _____	White-rayed pentachaeta _____	U.S.A. (CA) _____	E _____	_____	NA _____	NA _____
Brassicaceae—Mustard family:						
<i>Streptanthus albidus</i> _____ ssp. <i>albidus</i>	Metcalf Canyon jewelflower _____	U.S.A. (CA) _____	E _____	_____	NA _____	NA _____
<i>Streptanthus niger</i> _____	Tiburon jewelflower _____	U.S.A. (CA) _____	E _____	_____	NA _____	NA _____
Crassulaceae—Stonecrop family:						
<i>Dudleya setchevii</i> _____	Santa Clara Valley dudleya _____	U.S.A. (CA) _____	E _____	_____	NA _____	NA _____
Liliaceae—Lily family:						
<i>Calochortus tiburonensis</i> _____	Tiburon mariposa lily _____	U.S.A. (CA) _____	T _____	_____	NA _____	NA _____
Linaceae—Flax family:						
<i>Hesperolimon congestum</i> _____	Marin dwarf-flax _____	U.S.A. (CA) _____	T _____	_____	NA _____	NA _____
Onagraceae—Evening-primrose family:						
<i>Clarkia franciscana</i> _____	Presidio clarkia _____	U.S.A. (CA) _____	E _____	_____	NA _____	NA _____
Rhamnaceae—Buckthorn family:						
<i>Ceanothus ferrissae</i> _____	Coyote ceanothus _____	U.S.A. (CA) _____	E _____	_____	NA _____	NA _____
Scrophulariaceae—Snapdragon family:						
<i>Castilleja neglecta</i> _____	Tiburon paintbrush _____	U.S.A. (CA) _____	E _____	_____	NA _____	NA _____
<i>Cordylanthus tenuis</i> _____ ssp. <i>capillaris</i>	Pennell's bird's beak _____	U.S.A. (CA) _____	E _____	_____	NA _____	NA _____

Dated: November 24, 1992.

Richard N. Smith,

Acting Director, Fish and Wildlife Service.

[FR Doc. 92-30252 Filed 12-11-92; 8:45 am]

BILLING CODE 4310-55-M

50 CFR Part 17

RIN 1018-AB38

Endangered and Threatened Wildlife and Plants; Proposed Endangered Status for Three Plants from the Waianae Mountains, Island of Oahu, HI

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Proposed rule.

SUMMARY: The U.S. Fish and Wildlife Service (Service) proposes endangered status pursuant to the Endangered Species Act of 1973, as amended (Act), for three plants: *Cyanea grimesiana* ssp. *obatae* (haha), *Diellia unisora* (no common name (NCN)), and *Gouania vitifolia* (NCN). These taxa are known primarily from the Waianae Mountain Range, located on the island of Oahu, Hawaii. The three plant taxa and their habitats have been adversely threatened in various degrees by one or more of the following: Habitat degradation and competition for space, light, water, and nutrients by naturalized, alien vegetation; and habitat degradation and potential predation by feral animals. Because of the low number of extant individuals and severely restricted distributions, populations of these taxa are subject to an increased likelihood of extinction and/or reduced reproductive vigor from stochastic events. This proposal, if made final, would implement the Federal protection and recovery provisions provided by the Act. If made final, it would also implement State regulations protecting these plants as endangered species. Comments and materials related to this proposal are solicited.

DATES: Comments from all interested parties must be received by February 12, 1993. Public hearing requests must be received by January 28, 1993.

ADDRESSES: Comments and materials concerning this proposal should be sent to Robert P. Smith, Field Supervisor, Pacific Islands Office, U.S. Fish and Wildlife Service, 300 Ala Moana Boulevard, room 6307, P.O. Box 50167, Honolulu, Hawaii 96850. Comments and materials received will be available for public inspection, by appointment, during normal business hours at the above address.

FOR FURTHER INFORMATION CONTACT:
Derral R. Herbst, at the above address
(808/541-2749).

SUPPLEMENTARY INFORMATION:

Background

Cyanea grimesiana ssp. *obatae* and *Diellia unisora* are endemic to the Waianae Mountain Range on the western side of the island of Oahu, Hawaii. The only known extant population of *Gouania vitifolia* also occurs in the Waianae Mountains, but the species is known historically also from West Maui and the island of Hawaii.

The island of Oahu is formed from the remnants of two large shield volcanoes, the older Waianae Volcano on the west and the younger Koolau Volcano on the east. Because of the loss of their original shield volcano shape as the result of extensive erosion, today these volcanoes are called "mountains" or "ranges," and consist of long, narrow ridges. The Waianae Mountains were built by eruptions that took place primarily along three rift zones. The two principal rift zones run in a northwestward and south-southeastward direction from the summit, and a lesser one runs to the northeast. The range is approximately 40 miles (mi) (64 kilometers (km)) long. The caldera lies between the north side of Makaha Valley and the head of Nanakuli Valley (Macdonald *et al.* 1983). The Waianae Mountains are in the rain shadow of the parallel Koolau Mountains. Except for Mt. Kaala, the highest point on Oahu (4,020 feet (ft) (1,225 meters (m))), the Waianae receive much less rainfall (Wagner *et al.* 1990). The median annual rainfall for the Waianae Mountains varies from 20 to 75 inches (in) (51 to 191 centimeters (cm)), with only the small summit area of Mt. Kaala receiving the highest amount.

The land that supports these three plant taxa is owned by the State of Hawaii, the Federal government, and a private estate. Plants on Federal land are located on portions of Schofield Barracks Military Reservation and Lualualei Naval Reservation, both under the jurisdiction of the U.S. Department of Defense.

Discussion of the Three Taxa Proposed for Listing

Harold St. John described *Cyanea grimesiana* ssp. *obatae* based upon a specimen collected by John K. Obata in the Kaluaa Gulch of the Waianae Mountains, Oahu, in 1965 (St. John 1978). St. John named the subspecies in honor of its discoverer.

Cyanea grimesiana ssp. *obatae*, a member of the bellflower family

(Campanulaceae), is a shrub, usually unbranched, growing from 3.3 to 10.5 ft (1 to 3.2 m) tall. Its leaves are 10.5 to 23 in (27 to 58 cm) long by 5.5 to 12.5 in (14 to 32 cm) wide and are deeply cut into 9 to 12 lobes per side. The plant usually has small prickles on its stem and leaves. Clusters of 6 to 12 stalked flowers arise from the leaf axils. Sepals are fused to the ovary forming a cup 0.3 to 0.6 in (0.7 to 1.6 cm) long with small, narrow, triangular lobes at the tips. The petals are purplish or greenish to yellow-white, often washed or striped with magenta, and are about 2 to 3 in (5.5 to 8 cm) long and 0.2 to 0.4 in (0.5 to 1 cm) wide. Fruits are elliptical orange berries, 0.7 to 1.2 in (1.8 to 3 cm) long. This subspecies can be distinguished from the other two by its short, narrow, calyx lobes which are not fused or overlapping (Lammers 1990, St. John 1978).

Historically, *Cyanea grimesiana* ssp. *obatae* is known from the southern Waianae Mountains from Puu Hapapa to Kaaikukai (Hawaii Heritage Program (HHP) 1992a1 to 1992a6, Lammers 1990), a distance of about 4 mi (6.5 km). This taxon is known to be extant in Kaluaa, Ekahanui, and North Palawai Gulches, all on privately owned land, and on the slopes of Puu Hapapa in the Schofield Barracks Military Reservation (HHP 1992a2, 1992a5, 1992a6). The known extant plants total about 18 individuals in 4 populations (Joel Lau, HHP, pers. comm., 1992). *Cyanea grimesiana* ssp. *obatae* typically grows on steep, moist, shaded slopes in diverse mesic to wet forests at an elevation of 1,800 to 2,200 ft (550 to 670 m) (HHP 1992a2, Lammers 1990). Associated plants include both native and introduced species such as *Pipturus albidus* (mamaki), *Charpentiera* (papala), *Claoxylon sandwicense* (po'ola), *Pisonia* (papala kepa), *Acacia koa* (koa), *Aleurites moluccana* (kukui) and ferns (HHP 1992a2). The major threats to *Cyanea grimesiana* ssp. *obatae* are competition from alien plant species such as *Clidemia hirta* (Koster's curse) and *Schinus terebinthifolius* (Christmas berry) and stochastic extinction and/or reduced reproductive vigor due to the small number of extant individuals (HHP 1992a2). Habitat degradation by feral pigs is a potential threat (HHP 1992a2).

Donald L. Topping discovered *Diellia unisora* growing on a shaded, mossy bank in Pohakea Pass, Waianae Mountains, Oahu, in 1932. It was first reported and illustrated by Frances Smith (Smith 1934) who believed it to be a specimen of *Diellia pumila*, although she pointed out several differences between that species and the

ANTIOCH DUNES EVENING-PRIMROSE

(*Oenothera deltoides* subsp. *howellii*)

CLASSIFICATION:

Endangered (43 FR 17916).

CRITICAL HABITAT:

T.2N., R.2E., SW 1/4 of Section 17, and E 2/3 of S 1/3 of Section 18 (MDM), Contra Costa County.

DESCRIPTION:

Short-lived perennial herb to subshrub, forming large tufts with coarse drooping stems 4-8 dm long, much branched; leaves incised to sharply pinnatifid, lance-like in outline, 3-12 cm long, 1-3 cm wide, grayish with numerous short and fewer longer hairs; sepals 2-3 cm long, densely more or less glandular-pubescent and few to many fine wavy hairs 1-3 mm long, prominent free sepal tips in bud 1-3 mm long; petals 2-3 cm long; capsule 3-4 mm thick at base.

DISTRIBUTION:

The subspecies now occurs in three general localities, all near the confluence of the Sacramento and San Joaquin Rivers. The only natural stand of *Oenothera deltoides* subsp. *howellii* exists within the sand dunes near Antioch in Contra Costa county. The Fish and Wildlife Service placed most of the natural dune habitat within its refuge system with the purchase of two parcels in 1980. Pacific Gas and Electric, Domtar Gypsum, and a local citizen own the remaining habitat harboring the Antioch Dunes evening-primrose and the two other endangered species, Contra Costa wallflower (*Erysimum capitatum* var. *angustatum*) and Lange's metalmark butterfly (*Apodemia mormo langei*) near Antioch.

The subspecies also has been introduced into at least three different localities by Regional Parks Botanic Garden personnel since 1970. James Roof, late Director Emeritus of the garden, suggested a solution in a 1969 article to the mining activities that were quarrying out the remaining dunes prior to their acquisition by the Fish and Wildlife Service. He believed the "dispersal to remote dunes areas" might ensure the survival of the evening-primrose. As a result, Walter Knight, former staff member of the garden, sowed seed on "low dunes" at Brannan Island State Recreation Area in Sacramento County (Anonymous 1971). In addition, Roof introduced the subspecies onto the coastal dunes at Point Reyes National Seashore in Marin County (Anonymous 1971). Roof (1969) had discussed these two introduction sites as suitable sites for introduction of *Oenothera* seed. Although the experiment failed at Point Reyes, the subspecies became naturalized at Brannan Island and thrives there today. Knight also started two small colonies on Brown's Island in Contra Costa County in 1978. He believed the plant was doing well on the island; however, Alice Howard reported in 1982 that the evening-primrose appeared to be declining. The

historic range of *Oenothera deltooides* subsp. *howellii* is unknown and open to speculation. Presumably it was limited to the sandy soil type (Oakley or Delhi sand) found at the dunes and over a substantial portion of eastern Contra Costa County. Nevertheless, there's no known evidence that demonstrates that the subspecies historically occupied any area other than the Antioch Dunes proper. Future research may help resolve this question, however, this seems doubtful in view of the poor historical accounts and specimen collections.

SPECIAL CONSIDERATIONS:

Oenothera deltooides subsp. *cognata*, which grows in the Oakley area southeast of the dunes, can be confused with the endangered evening-primrose. The former has coarsely wavy or toothed leaf margins and blunt birds, while the latter has pinnatifid leaves and long-pointed birds. Moreover, *O. d.* subsp. *cognata* has yellow-green foliage and apparently is shorter-lived compared to *O. d.* subsp. *howellii*.

REFERENCES FOR ADDITIONAL INFORMATION:

- Anonymous. 1971. Antioch primrose sown out of range. *Four Seasons* 4(1):21.
- Howard, A. Q., and R. A. Arnold. 1980. The Antioch Dunes - Safe at last? *Fremontia* 8:3-12.
- Klein, W. M. 1962. New taxa and recombinations in *Oenothera* (*Anogra*). *Aliso* 5:179-180.
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- Munz, P. A. 1931. Studies in Onagraceae VI. The subgenus *Anogra* of the genus *Oenothera*. *Amer. J. Bot.* 18:314.
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- Roof, J. B. 1969. In memoriam: The Antioch Dunes. *Four Seasons* 3(1):2-4.
- U.S. Fish and Wildlife Service. 1984. Revised recovery plan for three endangered species endemic to Antioch Dunes, California. U.S. Fish and Wildlife Service, Portland, OR. 66 pp.

CONTRA COSTA WALLFLOWER
(*Erysimum capitatum* var. *angustatum*)

CLASSIFICATION:

Endangered (43 FR 17916)

CRITICAL HABITAT:

T.2N., R.2E. SW 1/4 of Section 17, and E 2/3 of S 1/3 of Section 18 (MDM), Contra Costa County, California

DESCRIPTION:

Erect, robust, coarse-stemmed, monocarpic perennial ("biennial") herb with simple or few branched stems 2-8 m tall; woody base much elongated and nearly 5 mm in diameter; basal leaves elongated lance-like to linear, tapering to a petiole at base and acute at apex; lowermost leaves 4-16 cm long, 0.5-1 cm wide with minutely-toothed margins; flowers in unbranched stalks bearing flowers laterally from a lengthening tip; petals 4, yellow, 1.5-2 cm long; stamens 6 (4 long and 2 short); seed pods (siliques) 4-angled slender, 5-10 cm long and usually under 2 mm broad.

DISTRIBUTION:

Roszbach (1958) believed that the Contra Costa wallflower was "restricted to more or less consolidated dunes of fine sand and some clay" near Antioch, Contra Costa County. He said the habitat was covered "with sparse herbs and shrubs, or less often with pasture grasses, herbs, and scattered" live oaks (*Quercus agrifolia*). Johnson (1978) suggested that reproducing individuals occurred principally on uneven sites (e.g., riverfronting cliff faces and edges). One of the more vigorous stands of wallflower was found in an excavated area within the dunes on private property owned by William McCullough. The wallflower was believed by Johnson to prefer areas neighboring the river bluffs. Price (pers. comm. 1982), however, recently discovered a large colony adjacent to a fence quite a distance from the river. The plant also grows inland on McCullough property amidst scrap metal and concrete rubble. Nonetheless, the wallflower appears to be more restricted within the dunes than the Antioch Dunes evening-primrose.

Fish and Wildlife Service botanists have observed the wallflower growing in steep areas of unstable sand. These slopes generally are not as densely vegetated, which may enable the wallflower to compete better for nutrients and water. However, the wallflower grew at one time on flat terrain on the McCullough property.

The wallflower planted within the Tilden Regional Park Botanic Garden was at last report thriving (Roof, pers. comm. 1981). The plant had nearly become a "weed" in cultivation, a character it apparently does not exhibit on the dunes. Roof (1969) felt the wallflower was the most adaptable to garden conditions of all the wallflowers he had cultivated.

SPECIAL CONSIDERATIONS:

The following data are for the Contra Costa wallflower at the Antioch National Wildlife Refuge for 1984 and 1985.

Stamm parcel (41 acres)		
Time period:	4/11/84	3/19/85
Flowering plants counted:	98	115*
Sardis parcel (14 acres)	4/13/84	4/4/85
	720	671**

* This figure includes 7 non-blooming wallflowers that were artificially seeded into our experimental plot, these should be blooming plants in 1986.

** This figure represents both the Sardis unit, PG&E-East and West units. Even though the area covered increased by approximately 10 acres the number of flowering plants decreased. This was undoubtedly due to the fires on the units in 1984. A number of first-year, non-flowering wallflowers were visible but these are not counted in the survey.

REFERENCES FOR ADDITIONAL INFORMATION:

Greene, E. L. 1976. Studies in the Cruciferae. *Pittonia* 3:117-138.

Roof, J. B. 1969. In memoriam: The Antioch Dunes. *Four Seasons* 3(1):2-4.

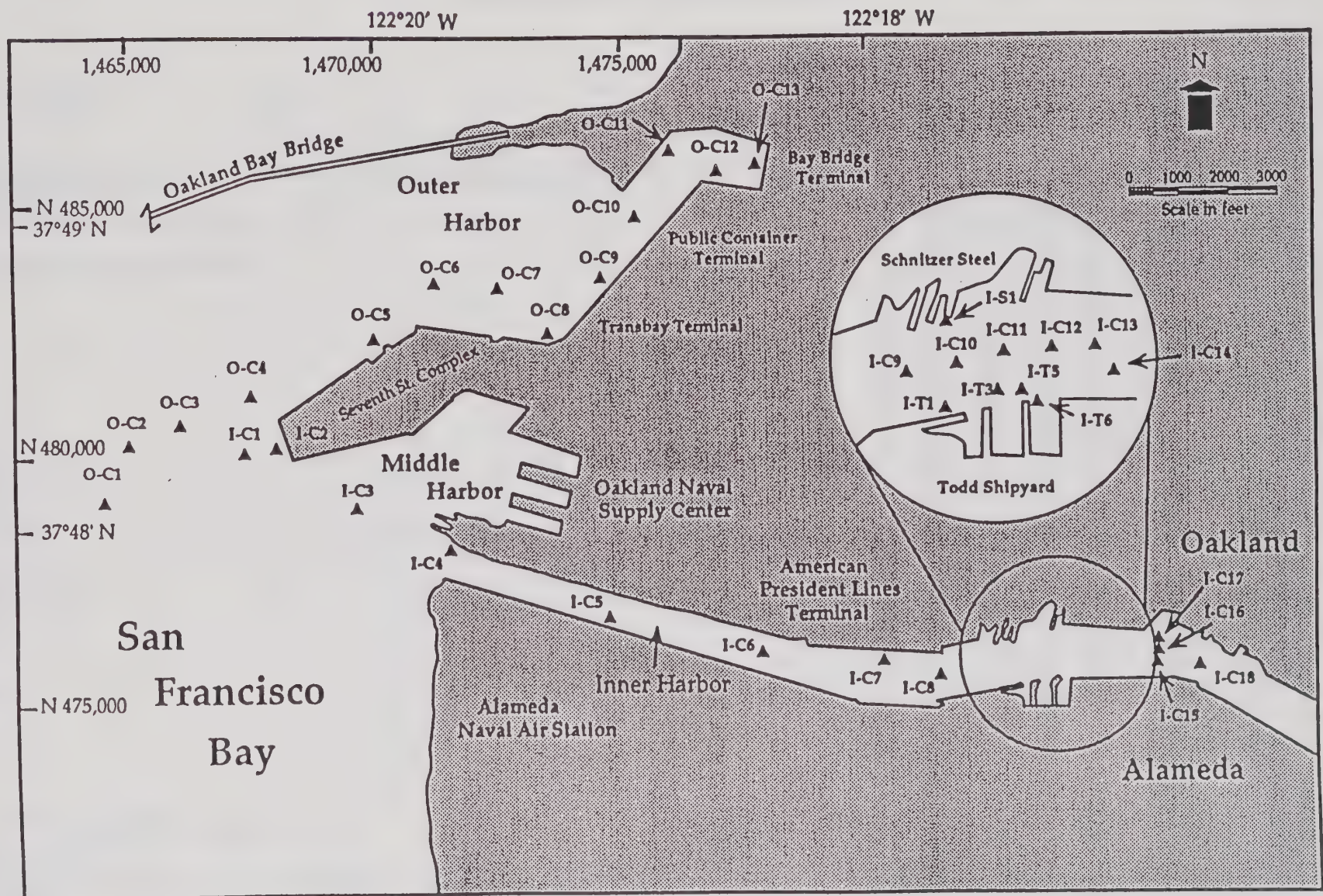
Roszbach, G. B. 1958. New taxa and new combinations in the genus *Erysimum* in North America. *Aliso* 4:115-124.

U.S. Fish and Wildlife Service. 1984. Revised recovery plan for three endangered species endemic to Antioch

Dunes, California. U.S. Fish and Wildlife Service, Portland, OR.

APPENDIX D

Groundwater Quality Data



Source: Lee et al. (1993) and HLA

Figure D-1
LOCATION OF SEDIMENT CORE SAMPLING STATIONS

**Table D-1. Groundwater Quality and Depth to Groundwater
Galbraith Golf Course and Leonard Ranch Areas**

	Leonard Ranch Area				Galbraith Golf Course Area				
Well/Piezometer Designation	LR5	LR6	LRP1	LRP3	G4c*	G5	G7d*	G13a	G13b
Well/Piezometer Coordinates	3N/6W/11L1	3N/6W/1Q1	3N/6W	3N/6W	2S/3W	2S/3W	2S/3W	2S/3W	2S/3W
Date Sampled	--	--	11/22/93	11/22/93	08/08/85	07/02/90	08/30/90	10/23/90	10/24/90
Source of Information	A	A	B	B	C, D	C, D	C, E	C, D	C, D
<u>Organic Compounds (ug/l)</u>									
Total Petroleum Hydrocarbons (TPH; gasoline/diesel)	NA	NA	NA	NA	NA	35	NA	ND	ND
Polynuclear Aromatic Hydrocarbons (PAH)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	NA	NA	NA	NA	NA	15	NA	ND	ND
Chlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	ND
Toluene	NA	NA	NA	NA	NA	ND (0.6)	NA	ND	ND
Ethylbenzene	NA	NA	NA	NA	NA	ND (0.7)	NA	ND	ND
Xylenes	NA	NA	NA	NA	NA	ND (2)	NA	ND	ND
Trichloroethene (TCE)	NA	NA	NA	NA	13	NA	17	ND	ND
trans-1,2-dichloroethene	NA	NA	NA	NA	900	NA	ND	ND	ND
Vinyl chloride	NA	NA	NA	NA	75	NA	ND	ND	ND
Phenols	NA	NA	NA	NA	NA	NA	NA	ND	ND
<u>Inorganics (mg/l)</u>									
Total Dissolved Solids (TDS)	829	811	23,300	13,400	NA	NA	NA	4345	6660
Sodium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloride	150	471	NA	NA	NA	NA	NA	944	2660
Calcium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA	NA	NA	NA	NA
CaCO ₃	NA	NA	NA	NA	NA	NA	NA	NA	NA
Alkalinity	NA	NA	NA	NA	NA	NA	NA	NA	NA
HCO ₃	NA	NA	NA	NA	NA	NA	NA	NA	NA
Depth to water (in feet below top of casing)	NA	NA	14.7	12.5	NA	8	NA	5.20	7.75
pH	NA	NA	7.2	6.5	NA	NA	NA	6.7	6.9

* Nearest of group of wells to site

+ Probable laboratory contaminant

NA Not available

ND Not detected

**Table D-1. Groundwater Quality and Depth to Groundwater
Galbraith Golf Course and Leonard Ranch Areas**

	Galbraith Golf Course Area									
Well/Piezometer Designation	G13c	G13d	G13e	G13f	G13g	G13h	G13i	G13j	G29	G30
Well/Piezometer Coordinates	2S/3W	2S/3W	2S/3W	2S/3W	2S/3W	2S/3W	2S/3W	2S/3W	2S/3W/33H3	2S/3W/28G1
Date Sampled	10/23/90	10/23/90	10/23/90	10/23/90	10/22/90	10/22/90	10/24/90	10/23/90	09/19/85	10/29/85
Source of Information	C, D	C, D	C, D	C, D	C, D	C, D	C, D	C, D	F	F
<u>Organic Compounds (ug/l)</u>										
Total Petroleum Hydrocarbons (TPH; gasoline/diesel)	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA
Polynuclear Aromatic Hydrocarbons (PAH)	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA
Benzene	23	10	ND	ND	ND	ND	ND	ND	NA	NA
Chlorobenzene	120	ND	ND	ND	ND	ND	ND	ND	NA	NA
Toluene	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA
Xylenes	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA
Trichloroethene (TCE)	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA
trans-1,2-dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA
Vinyl chloride	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA
Phenols	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA
<u>Inorganics (mg/l)</u>										
Total Dissolved Solids (TDS)	5,480	603	5,265	8,300	613	450	3,215	677	592	1,361
Sodium	NA	NA	NA	NA	NA	NA	NA	NA	54	132
Chloride	1,980	933	2,260	1,260	2,860	42.7	1,270	168	162	692
Calcium	NA	NA	NA	NA	NA	NA	NA	NA	98	225
Magnesium	NA	NA	NA	NA	NA	NA	NA	NA	43	86
CaCO ₃	NA	NA	NA	NA	NA	NA	NA	NA	422	916
Alkalinity	NA	NA	NA	NA	NA	NA	NA	NA	233	185
HCO ₃	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Depth to Water (in feet below top of casing)	9.60	7.95	10.27	10.00	11.03	4.50	9.07	7.67	NA	34
pH	7.3	7.4	7.0	7.4	6.9	7.0	6.8	7.2	8.2	7.8

**Table D-1. Groundwater Quality and Depth to Groundwater
Galbraith Golf Course and Leonard Ranch Areas**

	Galbraith Golf Course Area										
Well/Piezometer Designation	G31a	G31a	G31b	G31b	G31c	G31d	G31e	G31e	G31f	G31f	G31g
Well/Piezometer Coordinates	--	--	--	--	--	--	--	--	--	--	--
Date Sampled	4/22/91	10/27/93	4/22/91	10/27/93	4/23/91	4/23/91	4/23/91	10/27/93	4/24/91	10/27/93	4/24/91
Source of Information	G	G	G	G	G	G	G	G	G	G	G
<u>Organic Compounds (ug/l)</u>											
Total Petroleum Hydrocarbons (TPH; gasoline/diesel/motor oil)	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND(50)/ND(50)/510	NA
Polynuclear Aromatic Hydrocarbons (PAH)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	ND (1)	ND (0.5)	ND (1)	ND (0.5)	ND (1)	ND (1)	ND (1)	ND (0.5)	ND (1)	ND (0.5)	ND (1)
Chlorobenzene	ND (1)	ND (0.5)	ND (1)	ND (0.5)	ND (1)	ND (1)	ND (1)	ND (0.5)	ND (1)	ND (0.5)	ND (1)
Toluene	ND (1)	ND (0.5)	ND (1)	ND (0.5)	ND (1)	ND (1)	1.1	ND (0.5)	ND (1)	ND (0.5)	ND (1)
Ethylbenzene	ND (1)	ND (0.5)	ND (1)	ND (0.5)	ND (1)	ND (1)	ND (1)	ND (0.5)	ND (1)	ND (0.5)	ND (1)
Xylenes	ND (1)	ND (0.5)	ND (1)	ND (0.5)	ND (1)	ND (1)	ND (1)	ND (0.5)	ND (1)	ND (0.5)	ND (1)
Trichloroethene (TCE)	39	38	ND (1)	ND (0.5)	ND (1)	ND (1)	ND (1)	ND (0.5)	ND (1)	1.2	ND (1)
cis-1,2-dichloroethene	2.4	3.7	ND (1)	ND (0.5)	ND (1)	ND (1)	ND (1)	ND (0.5)	ND (1)	0.58	ND (1)
trans-1,2-dichloroethene	ND (1)	ND (0.5)	ND (1)	ND (0.5)	ND (1)	ND (1)	ND (1)	ND (0.5)	ND (1)	ND (0.5)	ND (1)
Vinyl chloride	ND (2)	ND (0.5)	ND (2)	ND (0.5)	ND (2)	ND (2)	ND (2)	ND (0.5)	ND (2)	ND (0.5)	ND (2)
Methylene chloride	9.3	ND (1)	ND (1)	ND (0.5)	2.0	ND (1)	ND (1)	ND (0.5)	ND (1)	ND (0.5)	ND (1)
Phenols	NA	NA	NA	ND (10)	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl) phthalate +	NA	NA	NA	ND (10)	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs	ND (0.1-0.5)	ND (0.1-0.5)	ND (0.1-0.5)	ND (0.1-0.5)	ND (0.1-0.5)	ND (0.1-0.5)	ND (0.1-0.5)	ND (0.1-0.5)	ND (0.1-0.5)	ND (0.1-0.5)	ND (0.1-0.5)

**Table D-1. Groundwater Quality and Depth to Groundwater
Galbraith Golf Course and Leonard Ranch Areas**

	Galbraith Golf Course Area										
Well/Piezometer Designation	G31a	G31a	G31b	G31b	G31c	G31d	G31e	G31e	G31f	G31f	G31g
Well/Piezometer Coordinates	--	--	--	--	--	--	--	--	--	--	--
Date Sampled	4/22/91	10/27/93	4/22/91	10/27/93	4/23/91	4/23/91	4/23/91	10/27/93	4/24/91	10/27/93	4/24/91
Source of Information	G	G	G	G	G	G	G	G	G	G	G
<u>Inorganics (mg/l)</u>											
Total Dissolved Solids (TDS)	850	563	910	539	7,000	8,700	56,000	58,900	11,000	18,300	6,100
Sodium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloride	110	52.5	240	40.5	3,100	4,000	30,000	16,200	4,700	10,500	2,000
Calcium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate	NA	5.2	NA	8.8	NA	NA	NA	ND (1.0)	NA	ND (1.0)	NA
Magnesium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CaCO ₃	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Alkalinity	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HCO ₃	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Depth to Water (in feet below top of casing)	6.65	6.48	5.70	5.60	4.64	9.39	14.58	15.10	10.42	10.03	8.39
pH	7.44	7.4	7.29	7.2	7.15	7.02	6.5	6.4	7.09	6.8	6.42

Table D-1. Groundwater Quality and Depth to Groundwater
Galbraith Golf Course and Leonard Ranch Areas

Well/Piezometer Designation Well/Piezometer Coordinates Date Sampled Source of Information	Galbraith Golf Course Area							
	G31h	G31i	G31j	G31k	G31l	G31m	G31n	G31o
	--	--	--	--	--	--	--	--
	4/25/91	4/25/91	10/27/93	10/27/93	10/27/93	10/27/93	10/27/93	10/27/93
	G	G	H	H	H	H	H	H
<u>Organic Compounds (ug/l) (CONTINUED)</u>								
Total Petroleum Hydrocarbons (TPH; gasoline/diesel/motor oil)	NA	NA	NA	NA	NA	NA	ND(50)/57/360	240/410/800
Polynuclear Aromatic Hydrocarbons (PAH)	NA	NA	ND (10-50)	ND (10-50)	ND (10-50)	ND (10-50)	ND (10-50)	ND (10-50)
Benzene	ND (1)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (5)
Chlorobenzene	ND (1)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (5)
Toluene	ND (1)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (5)
Ethylbenzene	ND (1)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (5)
Xylenes	ND (1)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (5)
Trichloroethene (TCE)	ND (1)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (5)
cis-1,2-dichloroethene	ND (1)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (5)
trans-1,2-dichloroethene	ND (1)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (10)
Vinyl chloride	ND (2)	ND (2)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (5)
Methylene chloride	ND (1)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (10)
Phenols	NA	NA	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)
bis(2-Ethylhexyl) phthalate +	NA	NA	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)
Pesticides/PCBs	ND (0.1-0.5)	ND (0.1-0.5)	ND (0.1-0.5)	ND (0.1-0.5)	ND (0.1-0.5)	ND (0.1-0.5)	ND (0.1-0.5)	ND (0.1-0.5)

**Table D-1. Groundwater Quality and Depth to Groundwater
Galbraith Golf Course and Leonard Ranch Areas**

	Galbraith Golf Course Area							
Well/Piezometer Designation	G31h	G31i	G31j	G31k	G31l	G31m	G31n	G31o
Well/Piezometer Coordinates	--	--	--	--	--	--	--	--
Date Sampled	4/25/91	4/25/91	10/27/93	10/27/93	10/27/93	10/27/93	10/27/93	10/27/93
Source of Information	G	G	G	G	G	G	G	G
<u>Inorganics (mg/l) (CONTINUED)</u>								
Total Dissolved Solids (TDS)	23,000	4,900	3,360	28,000	5,070	4,780	21,200	22,100
Sodium	NA	NA	NA	NA	NA	NA	NA	NA
Chloride	12,000	1,800	1,480	15,400	2,830	2,080	10,800	10,400
Calcium	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate	NA	NA	3.9	ND (10)	12.4	ND (1.0)	ND (10)	ND (10)
Magnesium	NA	NA	NA	NA	NA	NA	NA	NA
CaCO ₃	NA	NA	NA	NA	NA	NA	NA	NA
Alkalinity	NA	NA	NA	NA	NA	NA	NA	NA
HCO ₃	NA	NA	NA	NA	NA	NA	NA	NA
Depth to Water (in feet below top of casing)	14.43	17.83	4.14	6.66	7.75	7.80	10.08	9.55
pH	6.49	6.76	7.0	7.0	7.3	6.7	6.6	7.4

NOTE: The completeness of data presented in this table reflects the information available from the given sources.

- A California Department of Water Resources, 1982.
- B Harding Lawson Associates, 1993c.
- C California Department of Water Resources, review of files.
- D Regional Water Quality Control Board Files, Oakland Office.
- E Harding Lawson Associates, 1992.
- F Alameda County Flood Control and Water Conservation District, 1988.
- G Baseline Environmental Consulting, 1991.
- H Harding Lawson Associates, 1993, unpublished data.

**Table D-2. Groundwater Quality - Metals
Galbraith Golf Course Area**

Well/Piezometer Designation Well/Piezometer Coordinates Date Sampled Source of Information	G13a 2S/3W 2/9/90 C, D	G13b 2S/3W 2/8/90 C, D	G13c 2S/3W 2/8/90 C, D	G13d 2S/3W 2/8/90 C, D	G13e 2S/3W 2/8/90 C, D	G13f 2S/3W 2/8/90 C, D	G13g 2S/3W 2/8/90 C, D	G13h 2S/3W/ 2/9/90 C, D	G13i 2S/3W 2/8/90 C, D	G13j 2S/3W 2/8/90 C, D
METALS (mg/l)										
Aluminum	ND	0.536	0.457	ND	0.332	ND	0.420	ND	ND	ND
Antimony	ND	0.676	0.108	0.204	0.188	ND	ND	0.0802	ND	ND
Arsenic	0.042	0.019	ND	ND	0.112	ND	0.017	ND	0.025	ND
Barium	0.428	0.701	0.620	0.93	1.73	ND	0.254	ND	0.342	0.124
Beryllium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Boron	3.290	2.96	4.88	2.77	3.65	2.39	1.71	0.315	0.727	0.228
Cadmium	ND	0.001	ND	0.003	0.002	ND	ND	0.002	ND	0.001
Calcium	113	157	57.7	65.3	103	76.6	180	67	154	59.2
Chromium	ND	ND	46.5	ND	ND	ND	ND	0.0121	ND	ND
Cobalt	ND	ND	ND	ND	ND	0.0674	ND	ND	ND	ND
Copper	0.014	0.018	ND	0.036	0.026	0.016	0.032	0.021	ND	0.017
Iron	4.15	1.2	2.05	2.52	6.32	0.126	4.05	ND	1.06	ND
Lead	0.015	0.006	ND	0.009	ND	ND	ND	0.005	ND	ND
Magnesium	150	221	124	112	185	192	229	33.1	79	23.2
Manganese	0.662	1.49	0.176	0.227	1.29	0.222	8.33	ND	1.57	0.275
Mercury	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Molybdenum	ND	ND	ND	ND	0.03	0.0486	ND	ND	ND	ND
Nickel	0.184	0.182	ND	0.122	0.0748	0.120	0.093	ND	0.0428	ND
Potassium	138	43.4	77	11.6	93.8	87.3	30.5	ND	ND	ND
Selenium	0.0015	ND	ND	0.001	0.001	ND	ND	0.001	0.001	0.001
Silver	ND	0.0642	0.0218	ND	ND	ND	ND	ND	ND	0.0744
Sodium	1350	2370	1270	1820	1480	2670	1930	43	434	914
Thallium	ND	ND	ND	ND	ND	ND	0.015	ND	ND	ND
Tin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	0.0503	0.183	0.259	0.0794	0.0276	0.0207	0.0536	0.104	ND	0.148

ND = Not detected

NA = Not analyzed

Table D-2. Groundwater Quality - Metals
Galbraith Golf Course Area

Well/Piezometer Designation Well/Piezometer Coordinates Date Sampled Source of Information	G31a -- 4/22/91 G	G31b -- 4/22/91 G	G31c -- 4/23/91 G	G31d -- 4/23/91 G	G31e -- 4/23/91 G	G31f -- 4/24/91 G	G31g -- 4/24/91 G	G31h -- 4/25/91 G	G31i -- 4/25/91 H
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	ND(0.6)	ND(0.6)	ND(0.6)	ND(0.6)	ND(0.6)	ND(0.06)	ND(0.06)	0.0895	ND(0.06)
Arsenic	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)
Barium	0.0267	0.0775	0.8681	0.368	0.0673	0.0596	0.191	0.953	1.06
Beryllium	ND(0.002)	ND(0.002)	ND(0.002)	ND(0.002)	ND(0.002)	ND(0.002)	ND(0.002)	ND(0.002)	ND(0.002)
Boron	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.005)
Calcium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	ND(0.01)	ND(0.01)	ND(0.01)	0.024	0.02	0.0112	ND(0.01)	0.0112	ND(0.01)
Cobalt	ND(0.018)	ND(0.018)	ND(0.018)	ND(0.018)	0.0227	ND(0.018)	ND(0.018)	ND(0.018)	ND(0.018)
Copper	0.0226	0.0247	0.0579	0.0345	0.33	0.0746	0.0756	0.0373	0.0241
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	ND(0.06)	ND(0.06)	ND(0.06)	ND(0.06)	ND(0.06)	ND(0.06)	ND(0.06)	ND(0.06)	ND(0.06)
Magnesium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	ND(0.0002)	ND(0.0002)	ND(0.0002)	ND(0.0002)	ND(0.0002)	ND(0.0002)	ND(0.0002)	ND(0.0002)	ND(0.0002)
Molybdenum	ND(0.014)	ND(0.014)	ND(0.014)	ND(0.014)	ND(0.014)	ND(0.014)	ND(0.014)	ND(0.014)	ND(0.034)
Nickel	ND(0.032)	ND(0.032)	ND(0.032)	ND(0.032)	ND(0.032)	ND(0.032)	0.0648	ND(0.032)	ND(0.032)
Potassium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)
Silver	ND(0.01)	ND(0.01)	ND(0.01)	ND(0.01)	ND(0.01)	ND(0.01)	ND(0.01)	ND(0.01)	ND(0.01)
Sodium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)
Tin	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	ND(0.01)	ND(0.01)	ND(0.01)	ND(0.01)	ND(0.01)	0.0147	ND(0.01)	ND(0.01)	ND(0.01)
Zinc	ND(0.01)	0.0144	0.0388	0.0165	ND(0.1)	0.0664	0.036	ND(0.01)	ND(0.01)

Table D-2. Groundwater Quality - Metals
Galbraith Golf Course Area

Well/Piezometer Designation Well/Piezometer Coordinates Date Sampled Source of Information	G31a -- 10/27/93 G	G31b -- 10/27/93 G	G31e -- 10/27/93 G	G31f -- 10/27/93 G	G31j -- 10/27/93 H	G31k -- 10/29/93 H	G31l -- 10/27/93 H	G31m -- 10/27/93 H	G31n -- 10/27/93 H	G31o -- 10/29/93 H
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	ND(60)	ND(60)	ND(300)	ND(60)	ND(60)	ND (60)	ND(60)	ND(60)	ND(60)	ND (60)
Arsenic	ND(10)	ND(10)	13.1	ND(10)	ND(10)	15.3	ND(10)	ND(10)	ND(10)	
Barium	ND (100)	116	ND(500)	155	112	ND (100)	1,010	1,470	104	
Beryllium	ND(5.0)	ND(5.0)	ND(25.0)	ND(5.0)	ND(5.0)	ND (5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND (5.0)
Boron	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	ND(5.0)	ND(5.0)	ND(25)	ND(5.0)	ND(5.0)	ND (5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND (5.0)
Calcium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	ND(10)	ND(10)	ND(100)	ND(10)	ND(10)	ND (10)	ND(10)	ND(10)	ND(10)	ND (10)
Cobalt	ND(50)	ND(25)	ND(250)	ND(50)	ND(50)	ND (50)	ND(50)	ND(50)	ND(50)	ND (50)
Copper	ND (25)	ND (125)	ND(125)	ND(25)	ND(25)	ND (25)	ND(25)	ND(25)	ND(25)	ND (25)
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	3.0	3.0	24.3	ND(15)	ND (3)	ND (15)	1.0	5.7	23.4	ND (15)
Magnesium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	ND(0.20)	ND(0.20)	ND(1.0)	ND(0.20)	ND(0.20)	ND (0.2)	ND(0.20)	0.21	0.28	ND (0.2)
Molybdenum	ND(10)	ND(10)	ND(50)	ND(10)	21	40.4	ND(10)	ND(10)	ND(10)	ND (10)
Nickel	ND(40)	ND(40)	ND(200)	ND(40)	ND(40)	ND (40)	ND(40)	ND(40)	ND(40)	ND (40)
Potassium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND (10)	ND(10)	ND(10)	ND(10)	ND (10)
Silver	ND(10)	ND(10)	ND(50)	ND(10)	ND(10)	ND (10)	ND(10)	ND(10)	ND(10)	ND (10)
Sodium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	ND(50)	ND(50)	ND(100)	ND(50)	ND(50)	ND (50)	ND(50)	ND(50)	ND(50)	ND (50)
Tin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	ND(50)	ND(50)	ND(50)	ND(50)	ND(50)	ND (50)	ND(50)	ND(50)	ND(50)	ND (50)
Zinc	ND(20)	ND(20)	ND(100)	33.8	54.1	47.6	39.8	48.7	26.8	112

NOTE: The completeness of data presented in this table reflects the information available from the given sources.

- A California Department of Water Resources, 1982.
- B Harding Lawson Associates, 1993c.
- C California Department of Water Resources, review of files.
- D Regional Water Quality Control Board Files, Oakland Office.
- E Harding Lawson Associates, 1992.
- F Alameda County Flood Control and Water Conservation District, 1988.
- G Baseline Environmental Consulting, 1991.
- H Harding Lawson Associates, 1993, unpublished data.

APPENDIX E

Compliance of the Selected Plan with the Clean Water Act and the Marine Protection, Research, and Sanctuaries Act

APPENDIX E1

SECTION 404(b)(1) EVALUATION FOR THE PROPOSED NAVIGATION IMPROVEMENTS IN OAKLAND HARBOR, CALIFORNIA

1. PROJECT DESCRIPTION

A description of the proposed project can be found in Chapter 2 of the SEIR/S.

2. FACTUAL DETERMINATIONS

This section addresses the proposed discharge alternative, Alternative B2, Maximum Wetland Restoration, which includes placement of 2.9 million cubic yards (mcy) of dredged material at the Section 102 ocean site, 2.5 mcy at the Sonoma Baylands site, and 1.2 mcy at the Galbraith Golf Course site. This section discusses the potential effects of the proposed discharge on the aquatic environment of the Sonoma Baylands and the Galbraith site as appropriate. The Port of Oakland has applied for a Corps permit to, among other activities, discharge Oakland Harbor dredged material on Galbraith Golf Course, and that, in order to be eligible to receive the Corps permit, the Port must obtain Section 401 (Clean Water Act) water quality certification or a waiver of such. Disposal at the ocean site is not discussed in this 404(b)(1) evaluation because disposal at this site is not regulated by the Clean Water Act, but by the Marine Protection, Research, and Sanctuaries Act (MPRSA). Disposal at the ocean site, as entailed in Alternative B2, is evaluated according to the relevant requirements of the MPRSA in Appendix E2.

The Oakland Harbor dredging site is also not discussed because this component, and its impacts, is common to all alternatives except the No-Action Alternative, and thus does not enter into evaluation and comparison of the impacts of the alternatives. The environmental impacts of the project at the Oakland Harbor dredging site and for the Port/Landfill component are addressed in Section 4 of the SEIR/S, as are the impacts for the other sites. The No-Action Alternative would have essentially no impacts on the aquatic environment but would not achieve the objectives of the project.

2.1 PHYSICAL SUBSTRATE DETERMINATIONS

2.1.1 Substrate Elevation and Slope

The Sonoma Baylands wetlands restoration site is located in recent alluvium and bay muds along the floodplain of the Petaluma River.

The Galbraith Golf Course site consists of a golf course that was constructed over a landfill. The site is located in an area underlain by unconsolidated sediments, primarily tidal marshland deposits and stream-laid alluvium, and overlying artificial fill material from the filling of tidal flatlands (ACFCWCD 1988; BEC 1991; Wahler Associates 1987).

2.1.2 Sediment Type

The Sonoma Baylands site is an area underlain by unconsolidated Quaternary alluvium, bay mud deposits, and alluvial fan deposits and overlain by soil of the Reyes Series. The Reyes Series soil consists of poorly drained silty clays that have formed in mixed bay and stream alluvium.

The unconsolidated deposits at the Galbraith Golf Course site consist of gravel, sand, silt, and clay layers that have been differentiated into six geologic units: younger alluvium, fluvial deposits, interfluvial basin deposits, bay mud, Merritt Sand and older alluvium (ACFCWCD 1988).

2.1.3 Dredged/Fill Material Movement

At the Sonoma Baylands site, the existing interior drainage features, comprising a series of ditches that drain toward perimeter levees surrounding the site, will initially be altered by site regrading and the construction of perimeter levees to contain the dredged material. After construction of the perimeter levees and the placement of dredged materials, on-site discharges will be controlled by site operations. Discharges during construction will be controlled until the water meets RWQCB discharge requirements. Erosion and sedimentation will be minimized using topsoil to reestablish vegetation on the surrounding levees. Following full tidal circulation across the site, localized erosion in the existing tidal slough channels and the bordering marsh are expected. However, turbidity and sedimentation will be short term and eventually eliminated when equilibrium is established in the restored tidal marsh and tidal sloughs. This short-term impact is considered insignificant because high turbidity is characteristic of the water in dynamic tidal marsh environments.

Slurried dredged sediments will be placed within a confined disposal area at the Galbraith Golf Course site. Drainage will leave the site by an existing drainage channel that bisects the golf course. Sedimentation, erosion and discharge controls will be incorporated into the site design to eliminate movement of dredged material. The outboard slopes of the levees will be landscaped to reduce erosion. The decant water will be routed through vegetated ditches to enhance sedimentation before it is discharged.

2.1.4 Physical Effects on Benthos

The open water and intertidal mudflat at the Sonoma Baylands site would provide habitat for a wide variety of fauna including invertebrates such as amphipods, mollusks, gastropods and polychaetes. The net increase of wetlands from this project would result in a significant beneficial impact.

The benthic fauna at the Galbraith site are limited due to the seasonal nature of some of the wetlands.

2.1.5 Other Effects

There are no other significant effects to physical substrate at the Sonoma Baylands or Galbraith Golf Course sites.

2.1.6 Actions Taken to Minimize Impacts

No potential significant impacts are anticipated at the Sonoma Baylands or Galbraith Golf Course sites, consequently, no mitigation measures are warranted. The ocean disposal site is discussed in Appendix E2.

2.2 WATER CIRCULATION, FLUCTUATION, AND SALINITY DETERMINATIONS

2.2.1 Water

At the Sonoma Baylands site, on-site drainage is controlled by a series of ditches that bisect the central portion and lie along the northern perimeter of the site. Surface runoff in these ditches is directed southwest or northwest toward an ultimate point of concentration at an existing pumping station. This existing pumping station, located in the southwestern corner of the site, discharges the on-site surface runoff via a discharge pipe into San Pablo Bay. At the Sonoma Baylands site, the existing interior drainage features, comprising a series of ditches that drain toward perimeter levees surrounding the site, will initially be altered by site regrading and the construction of perimeter levees to contain the dredged material. After construction of the perimeter levees and the placement of dredged materials, on-site discharges will be controlled by site operations. Discharges during construction will be controlled until the water meets RWQCB discharge requirements. Erosion and sedimentation will be minimized using topsoil to reestablish vegetation. Following full tidal circulation across the site, localized erosion in the existing tidal slough channels and the bordering marsh are expected. However, turbidity and sedimentation will be short-term and eventually eliminated when equilibrium is established in the restored tidal marsh and tidal sloughs. This short-term impact is considered insignificant because high turbidity is characteristic of the water in dynamic tidal marsh environments.

The potential for infiltration of leachate and pore water from dredged materials to groundwater is considered minimal at the Sonoma Baylands site because essentially impermeable bay muds underlie the site. Shallow groundwater is expected to be brackish because of the proximity of the site to San Pablo Bay.

Prior to filling to create the Galbraith Golf Course site, surface water at the site was a marshland and tidal flat subject to flooding as freshwater drainage mixed with saline tidal flow. During filling of the site, the freshwater was channeled and a tidal gate was installed, which created a separation between the freshwater and the tidal flow water. As a result, most unchanneled surface water at the site drains vertically into the landfill cover material and laterally to man-made drainage channels in the central portion of the golf course (Aquascape 1990). These drainage channels flow to a single drainage channel that discharges into San Francisco Bay. Slurried dredged sediments will be placed within a confined disposal area at the Galbraith Golf Course site. Drainage will leave the site by an existing drainage channel that bisects the golf course. Sedimentation, erosion and discharge controls will be incorporated into the site design to eliminate movement of dredged material. Sediment traps, straw-bale dikes, silt fences and re-establishment of vegetation by hydroseeding on the inboard and outboard slopes of the levees will be used to control erosion and sedimentation of the dredged material. Potential impacts to the bay are negligible.

Groundwater at the site is composed of brackish, non-potable water in the western two-thirds and fresher water in the eastern third of the site. Saline water leached from the dredged sediments may impact potential sources of drinking water in the eastern third, but not the brackish water in the western two-thirds of the site. Potential impacts to the bay are negligible.

2.2.1.1 Salinity

Salinity measurements range from 3,000 ppm to 12,000 ppm, from ponded surface water sampled near the pump station on the Sonoma Baylands (CCCSLT 1989). Salinity measurements are not available from the Galbraith Golf Course site.

Salinity in San Pedro Bay and San Francisco Bay will not be impacted from dredged sediment disposal at the Sonoma Baylands or Galbraith Golf Course sites.

2.2.1.2 Water Chemistry

Surface water quality in the vicinity of the Sonoma Baylands site is predominantly brackish from proximity to San Pablo Bay. Water samples collected from the mouth of the Petaluma River at low and high tide contained chloride concentrations of 14,200 and 14,800 mg/l, turbidity of 53.0 and 105 NTU, total suspended solids of 111 and 198 mg/l, Ph of 7.6 and 7.9, specific conductance of 32,000 and 32,800 μ mhos/cm, and total dissolved solids of 25,400 and 26,400 mg/l, respectively.

There is no surface water quality data for the Galbraith Golf Course site, although concentrations of fertilizers, herbicides, and pesticides are expected in runoff from the golf course.

2.2.1.3 Clarity

Not applicable.

2.2.1.4 Color

Not applicable.

2.2.1.5 Odor

Not applicable.

2.2.1.6 Taste

Not applicable.

2.2.1.7 Dissolved Gas Levels

No data were available.

2.2.1.8 Nutrients

Water samples collected from the mouth of the Petaluma River adjacent to the Sonoma Baylands site at low and high tide contained chloride concentrations of 14,200 and 14,800 mg/l. The disposal of dredged sediments at the Sonoma Baylands site would not impact nutrients in San Pedro and San Francisco Bays.

No data were available for the Galbraith Golf Course site.

2.2.1.9 Eutrophication

At the Sonoma Baylands site, after construction of the perimeter levees and the placement of dredged materials, on-site discharges will be controlled by site operations. San Pablo Bay will not be impacted by eutrophication from disposal of dredged sediments at Sonoma Baylands site.

Drainage will leave the Galbraith Golf Course site by an existing drainage channel that bisects the golf course. Sedimentation, erosion and discharge controls will be incorporated into the site design to eliminate input of nutrients into the bay. The impact to San Francisco Bay is negligible from eutrophication because of the implementation of these best management practices.

2.2.1.10 Others as Appropriate

Not applicable.

2.2.2 Current Patterns and Circulation

2.2.2.1 Current Patterns and Flow

The Sonoma Baylands site is potentially subject to flooding from overbank flood flows from the Petaluma River, high tides and coastal wave action from San Pablo Bay, or a combination of the potential flooding mechanisms. The entire site is within a Zone VI flood hazard area, although much of the site and adjacent areas are surrounded by levees and dikes. Impacts to San Pablo Bay are negligible.

Prior to the filling of the site, surface water at the Galbraith Golf Course site was a marshland and tidal flat subject to flooding as freshwater drainage mixed with saline tidal flow. During filling of the site, the freshwater was channeled and a tidal gate was installed, which created a separation between the freshwater and the tidal flow water. As a result, most unchanneled surface water at the site drains vertically into the landfill cover material and laterally to man-made drainage channels in the central portion of the golf course (Aquascape 1990). These drainage channels flow to a single drainage channel that discharges into San Francisco Bay. Impacts to San Francisco Bay are negligible.

2.2.2.2 Velocity

No data were available.

2.2.2.3 Stratification

Not applicable.

2.2.2.4 Hydrologic Regime

Dredged material would be deposited at the Sonoma Baylands site to restore 348 acres of a deceit and subsided former intertidal northern coastal salt marsh (Corps 1993). Restoration would be accomplished by upgrading existing and constructing new perimeter levees, constructing interior peninsulas, and raising the elevation of the subsided site using dredged materials. Surface water drainage patterns would change,

but new drainages would be included in the design of the restoration project. Impacts to San Pablo Bay would be negligible from current hydraulic connection with brackish water.

At the Galbraith Golf Course site, land clearing, construction of perimeter levees, and discharge of dredged materials into cells may affect surface water flow direction and hydraulic head of groundwater in the wetland area. However, this impact would be limited only to the local disposal area and would not affect the regional surface water flow patterns and interaction with groundwater. Impacts to San Francisco Bay are negligible.

2.2.3 Normal Water Level Fluctuations

Water level fluctuations in the wetland may be impacted locally from the weight of the dredged material in the disposal cells. However, this impact would be limited only to the local disposal area and would not affect the regional water level.

2.2.4 Salinity Gradients

Refer to section 2.2.1.1 of this 404(b)(1) evaluation for a discussion of salinity.

2.2.5 Actions that will be Taken to Minimize Impacts

No potential significant impacts are anticipated at the Galbraith Golf Course or Sonoma Baylands sites; however, actions will be taken to minimize potential impacts to San Pablo and San Francisco bays. Actions include construction of perimeter levees and dikes with discharge controls at Sonoma Baylands and sedimentation, erosion, and discharge control at the Galbraith Golf Course site.

2.3 SUSPENDED PARTICULATE/TURBIDITY DETERMINATIONS

2.3.1 Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Site

At the Sonoma Baylands site, after construction of the perimeter levees and the placement of dredged materials, on-site discharges will be controlled by site operations. Discharges during construction will be controlled until water meets RWQCB discharge requirements. Erosion and sedimentation will be minimized using topsoil to reestablish vegetation. Following full tidal circulation across the site, localized erosion in the existing tidal slough channels and the bordering marsh are expected. However, turbidity and sedimentation will be short-term and eventually eliminated when equilibrium is established in the restored tidal marsh and tidal sloughs. This short-term impact is considered insignificant because high turbidity is characteristic of the water in dynamic tidal marsh environments. The impact to suspended particulates and turbidity levels in the vicinity of the site is negligible because of the implementation of these best management practices.

No increase in suspended particles and turbidity levels are expected from disposal at the Galbraith Golf Course site. No significant effects on plankton are anticipated at the Sonoma Baylands site, as particulates in the decant water will be allowed to settle before discharge. Similarly, the decant water from the Galbraith disposal site will be routed through vegetated ditches to enhance sedimentation before

it is discharged. Thus, significant changes in suspended solid loads should not occur that could effect plankton productivity.

2.3.2 Effects (degree and duration) on Chemical and Physical Properties of the Water Column

2.3.2.1 Light Penetration

No data were available.

2.3.2.2 Dissolved Oxygen

No data were available.

2.3.2.3 Toxic Metals and Organics

No potential significant impacts to San Pablo Bay are anticipated from disposal of dredged sediments at the Sonoma Baylands site.

Upland disposal at the Galbraith Golf Course site could result in significant impacts on groundwater quality from the potential release of salt, metals, tributyltin, and total PAHs. The proposed facility is underlain by Bay mud, and the project will include the installation of a subsurface perimeter cutoff wall to attenuate contaminants contained in the landfill fluid. The subsurface containment wall will attenuate fluid migration, thereby preventing degradation of groundwater outside the facility.

2.3.2.4 Pathogens

No data were available.

2.3.2.5 Aesthetics

No potential significant impacts are anticipated at the Sonoma Baylands or Galbraith Golf Course sites.

2.3.2.6 Others as Appropriate

Not applicable.

2.3.3 Effects on Biota

The Sonoma Baylands project would convert the site into a succession of open water, intertidal mudflat and salt marsh, separated by branched interior levees. The proportions of these habitats would vary over time, and would enhance productivity at all trophic levels and substantially increase species diversity and richness. The open water and intertidal mudflat would provide habitat for a wide variety of fauna including invertebrates (amphipods, mollusks, gastropods, polychaetes), fish (goby, bass, perch, flounder) and birds (pelicans, ducks, cormorants, grebes, terns, gulls). The salt marsh would support numerous vascular plants including cordgrass, pickleweed, and alkali heath. This habitat could provide roosting, nesting, and cover for numerous birds (herons, egrets, ducks, hawks, and shorebirds) including the California clapper rail. Mammals such as shrews, raccoon, and the salt marsh harvest mouse could also

use this salt marsh habitat and uplands areas on the interior levees for foraging, cover, and nesting. The proposed project would result in a net increase in wetland value, which is a significant beneficial impact.

At the Galbraith site, land clearing activities would result in the temporary loss of turf areas and ornamental landscaping along fairways of the golf course (129 acres). The site provides potentially suitable habitat for special-status taxa reported to occur in the area, including burrowing owl (see Table C-2 in Appendix C of the SEIR/S). The managed landscape provides foraging habitat for a variety of wildlife taxa in the area, including the burrowing owl and numerous other special-status avian visitors listed in Table 3.3.7-1 in the SEIR/S. However, because of the low habitat quality provided by this highly managed landscape, loss of golf course vegetation would not be considered significant. Approximately 13 acres of the entire site have been identified as wetlands (Figure 3.4.3.6-1 in the SEIR/S). Clearing, construction of perimeter levees, and discharge of dredged materials into cells will result in the loss of approximately 3.7 acres of wetlands, tidal lands, and other waters of the United States (exact acreage to be determined by the Corps). This is considered to be a significant adverse impact. Dewatering areas may attract shorebirds and waterfowl, and additional bird activity increases (statistically) the potential risk of bird-aircraft collision. The statistical risk is not considered a significant impact to biological resources. Excessive noise can interfere with wildlife behavior and result in stress and habitat or nesting abandonment. Noise generated from site preparation activities and operation of the unloading station and booster pumps may affect sensitive wildlife receptors (vertebrates) in the area. However, considering the short duration of the construction activities and the current high levels of background noise (section 3.6 in the SEIR/S), this impact is considered not significant.

2.3.3.1 Primary Production, Photosynthesis

The Sonoma Bayland restoration project would result in a net increase in wetland values, increasing primary production and photosynthesis.

At the Galbraith Golf Course site, land clearing and construction of the perimeter levees may impact primary production and photosynthesis, but at negligible levels and only at the local area of disposal.

2.3.3.2 Suspension/Filter Feeders

The open water and intertidal mudflat at the Sonoma Baylands site would provide habitat for a wide variety of fauna including invertebrates such as amphipods, mollusks, gastropods and polychaetes. The net increase of wetlands from this project would result in a significant beneficial impact.

No data were available for the Galbraith Golf Course site.

2.3.3.3 Sight Feeders

The open water and intertidal mudflat at the Sonoma Baylands site would provide habitat for a wide variety of fauna including fish such as goby, bass, perch and flounder. The net increase of wetlands from this project would result in a significant beneficial impact.

No data were available for the Galbraith Golf Course site.

2.3.4 Actions Taken to Minimize Impacts (Subpart H)

Minimal impacts are anticipated at the Sonoma Baylands site. Preconstruction nesting surveys and noise controls will result in negligible impacts to biota. There are impacts to biota at the Galbraith Golf Course site. The preferred mitigation option is impact avoidance by constructing perimeter levees and discharging dredged materials outside wetland areas. Unavoidable impacts to wetlands at the Galbraith Golf Course would be mitigated by creation of compensatory on-site wetlands at a ratio of 1.1:1 to 1.3:1 on an acreage basis.

2.4 CONTAMINANT DETERMINATIONS

No significant contaminant impacts are expected from disposal of dredged sediment at the Sonoma Baylands site.

At the Galbraith site, perimeter levees will be constructed to contain the dredged sediment and the potential contaminant impacts to wetlands will not be considered significant.

2.5 AQUATIC ECOSYSTEMS AND ORGANISM DETERMINATIONS

2.5.1 Effects on Plankton

No significant effects on plankton are anticipated at the Sonoma Baylands site, as particulates in the decant water will be allowed to settle before discharge. Similarly, the decant water from the Galbraith disposal site will be routed through vegetated ditches to enhance sedimentation before it is discharged. Thus, significant changes in suspended solid loads should not occur that could effect plankton productivity.

2.5.2 Effects on Benthos

The open water and intertidal mudflat at the Sonoma Baylands site would provide habitat for a wide variety of fauna including invertebrates such as amphipods, mollusks, gastropods and polychaetes. The net increase of wetlands from this project would result in a significant beneficial impact.

The benthos at the seasonal wetland and open water areas (3.7 acres) within the dredged material facility will be destroyed by the proposed project. Similar benthic communities are expected to establish naturally in the seasonal wetland areas to be created as mitigation for this loss.

2.5.3 Effects on Nekton

The open water and intertidal mudflat at the Sonoma Baylands site would provide habitat for a wide variety of fauna including fish such as goby, bass, perch and flounder. The net increase of wetlands from this project would result in a significant beneficial impact.

Any nekton present in the portion of the drainage channel to be culverted may be destroyed by construction activities. Abundance of nekton in this portion of the drainage channel will probably be limited in the future due to the culvert. No nekton are expected to occur in the seasonal wetlands, since they are isolated and quite small.

2.5.4 Effects on Aquatic Food Web

The aquatic food web is not expected to be altered by the disposal activity at Sonoma Baylands. Productivity in the culverted section of the drainage channel at the Galbraith site will decrease with the project. Productivity rates of the mitigation wetlands, once established, should be equivalent to the destroyed seasonal wetlands.

2.5.5 Effects on Special Aquatic Sites

No special aquatic areas such as marine or estuarine sanctuaries or important aquatic sites will be modified or altered by disposal at the Sonoma Baylands or Galbraith Golf Course sites.

2.5.5.1 Sanctuaries and Refuges

Not applicable.

2.5.5.2 Wetlands

The Sonoma Baylands project would convert the site into a succession of open water, intertidal mudflat and salt marsh, separated by branched interior levees. The proportions of these habitats would vary over time, and would enhance productivity at all trophic levels and substantially increase species diversity and richness. The proposed project would result in a net increase in wetland value, which is a significant beneficial impact.

There may be a localized effect on the ecosystem in the area of disposal at the Galbraith Golf Course site. The site provides potentially suitable habitat for special-status taxa reported to occur in the area, including burrowing owl (see Table C-2 in Appendix C of the SEIR/S). Land clearing, construction of perimeter levees, and discharge of dredged materials into cells will result in the loss of approximately 3.7 acres of seasonal freshwater wetlands, tidal lands, and other waters of the United States (exact acreage to be determined by the Corps). Unavoidable loss of wetlands and open water at the Galbraith Golf Course would be mitigated by creation of compensatory on-site wetlands at a ratio of 1.1:1 to 1.3:1 on an acreage basis. The final ratio will be determined once the design of the mitigation areas is finalized and permitted (Figure 2.7.6-1). The variance depends on the design of the wetland edge and buffer areas since the absolute acreage available is limited by two factors: (1) FAA regulations regarding creation of features to attract wildlife within the runway protection zones; and (2) the limited acreage of undeveloped upland areas within the Metropolitan Oakland International Airport. The proposed mitigation areas will be designed to provide greater habitat value than the existing wetlands to be replaced because they will be contiguous and maintained. This would mitigate wetland impacts to a less than significant level.

2.5.5.3 Mud Flats

Mud flats are not expected to be altered by the disposal activity at Sonoma Baylands or Galbraith Golf Course sites.

2.5.5.4 Vegetated Shallows

Vegetated shallows are not expected to be altered by the disposal activity at Sonoma Baylands or Galbraith Golf Course sites.

2.5.5.5 Coral Reefs

Not applicable.

2.5.5.6 Riffle and Pool Complexes

Not applicable.

2.5.5.7 Threatened and Endangered Species

Preconstruction nesting surveys at the Sonoma Baylands must be conducted to identify nest sites in the project area. In the event that active nests are located within 500 feet of the offloading station, pipeline route, or marsh outlet channel, no construction work would be permitted during the nesting season (February 1 through August 31 depending upon which taxa is found). Mitigation is necessary to control noise generated from the off-loading platform and booster pump. Pumps should be fitted with mufflers and surrounded by an insulated enclosure that reduces noise to acceptable levels. These measures would reduce this impact to a less than significant level at the Sonoma Baylands.

No special status species are known at the Galbraith site (Harvey 1993). A preconstruction survey will be performed for burrowing owls, a state-protected species. If owls are found, the owls and their burrows will be transplanted off site. If the pipeline to the Galbraith site is placed in San Leandro Bay, it will be placed at least 500 feet from Arrowhead Marsh to avoid impacts to clapper rails.

2.5.5.8 Other Wildlife

Other terrestrial wildlife (e.g., birds, mammals) may be impacted at the Galbraith site, but are capable of foraging in unaffected areas within the region, and should not be significantly affected by any reduction in prey. Planting and maintenance of vegetation at the Galbraith site would reduce impacts to other wildlife to levels below significance thresholds.

2.5.5.9 Actions to Minimize Impacts

Minimal impacts are anticipated at the Sonoma Baylands site. Preconstruction nesting surveys and noise controls will result in negligible impacts to aquatic organisms. There are no significant impacts to aquatic organisms at the Galbraith Golf Course site; however, if burrows of burrowing owls are identified during a preconstruction survey, they will be relocated off site.

2.6 PROPOSED DISPOSAL SITE DETERMINATIONS

2.6.1 Mixing Zone Determination

Not applicable.

2.6.2 Determination of Compliance with Applicable Water Quality Standards

Applicable water quality standards will be met at the Sonoma Bayland and Galbraith Golf Course sites.

2.6.3 Potential Effects on Human Use Characteristics

No impacts to existing drinking water supplies are expected at the Sonoma Baylands or Galbraith Golf Course sites because existing domestic water supply wells are upgradient at both sites.

2.6.3.1 Municipal and Private Water Supply

The potential for infiltration of leachate and pore water from dredged materials to groundwater is considered minimal at the Sonoma Baylands site because essentially impermeable bay muds underlie the site. Both surface water and shallow groundwater is expected to be brackish and not a potential source of drinking water because of the proximity of the site to San Pablo Bay. The nearest existing domestic supply wells are upgradient of the site.

Upland disposal at the Galbraith Golf Course site could result in significant impacts on surface and groundwater quality from the potential release of salt, metals, tributyltin and total PAHs, although such impacts are not expected. Surface water at the point of effluent discharge is expected to be saline and not a potential source of drinking water because of the proximity of the site to San Francisco Bay. No significant impacts to surface water drinking water supplies are expected. Groundwater at the site is composed of brackish, non-potable water in the western two-thirds and fresher water in the eastern third of the site. Saline water leached from the dredged sediments may impact potential sources of drinking water in the eastern third, but not the brackish water in the western two-thirds of the site. However, no impacts to existing drinking water supplies are expected because existing domestic water supply wells are upgradient of the site.

2.6.3.2 Recreational and Commercial Fisheries

There is no impact to recreational or commercial fisheries from disposal of sediments at the Sonoma Baylands or Galbraith sites.

2.6.3.3 Water Related Recreation

There is no significant impact to water related recreational activities from disposal of sediments at the Sonoma Bayland or Galbraith sites.

2.6.3.4 Aesthetics

Construction activities at the Sonoma Bayland site may interfere with aesthetics. Measures to mitigate the potential construction-related impacts include mufflers and insulated structures to reduce noise.

There are only minimal aesthetic impacts at the Galbraith site. At the Galbraith site, land clearing, construction of perimeter levees, and discharge of dredged materials into cells will result in the loss of approximately 3.7 acres of wetlands, tidal wetlands, and other waters of the United States (exact acreage to be determined by the Corps). Unavoidable loss of wetlands at the Galbraith site would be mitigated

by creation of compensatory on-site wetlands at a ratio of 1.1:1 to 1.3:1 on an acreage basis. Excessive noise from the site preparation activities, booster pumps, and operation of the unloading station may have short-term impacts to the aesthetics. The overall impact at the Galbraith site is not significant.

2.6.3.5 Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves

Not applicable.

2.7 DETERMINATION OF CUMULATIVE EFFECTS ON THE AQUATIC ECOSYSTEM

Based on the above discussion, no cumulative effects on the aquatic ecosystem are anticipated for the Sonoma Baylands and Galbraith Golf Course sites.

2.8 DETERMINATION OF SECONDARY EFFECTS ON THE AQUATIC ECOSYSTEM

No secondary effects on the aquatic ecosystem are anticipated for the Sonoma Bayland or Galbraith Golf Course sites.

3.0 FINDINGS OF COMPLIANCE OR NON-COMPLIANCE WITH RESTRICTIONS ON DISCHARGE

3.1 ADAPTATION OF THE SECTION 404(b)(1) GUIDELINES TO THIS EVALUATION

This section describes alternatives to the proposed action of dredging approximately 6.6 mcy of marine sediment from the Port of Oakland, California. As a matter of policy, the Corps of Engineers does not issue itself a permit under Sections 9 and 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. However, the Corps complies with the same laws that apply to application permits. The Port of Oakland has submitted a permit application to the Corps of Engineers for dredging of the Harbor berths and filling portions of the Galbraith site and culverting a drainage channel. This analysis of alternatives focuses upon the range of alternatives that will be available for the Federal portion of the project with the Port of Oakland responsible for the elements associated with the non-Federal portion of the proposed project. Since the District Engineer is required to coordinate with local agencies on related aspects of the Proposed Action and it is unclear as to which portions of the Proposed Action may be the local responsibility, this alternative analysis addresses all known Section 404 aspects of the Proposed Action.

3.2 EVALUATION OF AVAILABILITY OF PRACTICABLE ALTERNATIVES TO THE PROPOSED DISCHARGE SITE WHICH WOULD HAVE LESS ADVERSE IMPACT ON THE AQUATIC ECOSYSTEM

The following section summarizes the potential adverse impacts on the aquatic ecosystem of each alternative to the disposal of dredged material at the proposed site. A detailed evaluation of each alternative is provided in Appendix G of the SEIR/S (references below to sections that start with "G" are to this Appendix G).

3.2.1 No Action Alternative

The No-Action Alternative assumes that the project would not be implemented. No change in the biological community in Oakland Harbor and at the three aquatic disposal sites (Alcatraz, Ocean 102, and Bay Farm Borrow Area) would occur as a result of the No-Action Alternative.

3.2.2 Alternative A1 (Ocean/Galbraith Golf Course)

Biology

At the Galbraith site, land clearing, construction of perimeter levees, and discharge of dredged materials into cells will result in a loss of approximately 3.7 acres of seasonal freshwater wetlands, tidal wetlands, and other waters of the United States (exact acreage to be determined by the Corps). The site provides potentially suitable habitat for special-status taxa reported to occur in the area, including the burrowing owl (see Table C-2 in Appendix C of the SEIR/S). Dewatering areas may attract shorebirds and waterfowl, and additional bird activity increases the potential risk of bird-aircraft collision. Excessive noise from the site preparation activities, operation of the unloading station, and booster pumps may also interfere with wildlife behavior.

Water Quality

At the Galbraith Golf Course, most unchanneled surface water at the site drains vertically into the landfill cover material and laterally to man-made drainage channels in the central portion of the golf course (Aquascape 1990). These drainage channels flow to a single drainage channel that discharges into San Francisco Bay. Potential impacts from surface water flow into the bay are negligible.

Groundwater at the site is composed of brackish, non-potable water in the western two-thirds and fresher water in the eastern third of the site. Saline water leached from the dredged sediments may impact potential sources of drinking water in the eastern third, but not the brackish water in the western two-thirds of the site. Potential impacts to the bay are negligible.

3.2.3 Alternative A2 (Ocean/Leonard Ranch/Redwood Landfill)

Biology

Use of the Leonard Ranch/Redwood Landfill site under this alternative would result in the filling of 45 acres of seasonally inundated marshlands and 2 acres of ditches that presently contain freshwater wetland and aquatic habitats. Sensitive bird species nest in the salt marsh bordering San Pablo Bay and these species, if and where present, could be adversely affected by noise and activity associated with site construction and dredge disposal.

Water Quality

After the addition of dredged material, on-site runoff will be altered to flow to a single point of discharge at an existing 30-inch corrugated metal pipe (CMP) on the southern property boundary (see Figure 3.2.4.4-4 of the SEIR/S). This CMP will direct the on-site surface drainage and the decant and effluent water into the existing perimeter channel that drains toward the existing pump station in the southwestern

corner of the adjacent Sonoma Baylands site. This pumping station, located at the terminus of the channel, discharges flow through a pipe into the Petaluma River. The project design will eliminate any potential impacts from the release of elutriate water into San Pablo Bay because discharges to adjacent surface waters will be controlled by site operations until the on-site waters meet discharge standards. Additionally, preservation and maintenance of the existing levees and dikes surrounding the site will protect project operations from having significant impacts on the flooding potential of the area. No significant impacts to water quality from Leonard Ranch/Redwood Landfill surface water to San Pablo Bay are anticipated.

Shallow groundwater in this area is generally saline. The dredged material is isolated from deeper, possibly higher quality groundwater aquifer by a layer of impermeable bay mud. Contaminants are not expected to impact the deeper aquifer. Impacts to San Pablo Bay water quality from groundwater is not expected.

3.2.4 Alternative B1 (Ocean/Montezuma Wetlands)

Biology

Under this alternative, approximately 6.4 mcy would be disposed at the Montezuma Wetlands site. This is 28 percent of the total capacity (20 mcy) of the Montezuma Wetlands Project as proposed (Solano County 1993). Hence, the Port of Oakland's use of this site would contribute substantially to the impacts identified for the development of the Montezuma Wetlands Project as a whole (Solano County 1993). These impacts include the loss or modification of approximately 1,600 acres of wetland habitat, which, as a result of project design, may be converted to alternative types of wetland and aquatic habitats. Leaching or plant uptake of contaminants in dredge spoils may allow these contaminants to enter the food chain and potentially affect sensitive wildlife species, including state- and federally protected fish and migratory bird species. Losses of habitat and population may occur for a number of sensitive, plant and wildlife species on the site; these impacts remain to be defined. The Montezuma Wetlands Project would eliminate approximately 524 acres of habitat for the salt marsh harvest mouse, a federally listed endangered species.

Water Quality

On-site drainage and surface runoff will be altered by placement of dredged materials and by construction of containment cells, cell and phase levees, resettlement and storage ponds, the subdrain system, and tidal channels. Existing perimeter levees will be repaired and maintained. Excess water would be drawn from the sediments through the pond drainage system and a separate system of subdrains, which would require several collection trenches and/or discharge points. Water from placement operations would be periodically discharged into the Sacramento River and/or Suisun Bay to maintain acceptable salinity concentrations for placement operations and when excess water is not needed. Decant water from the rehandling facility would be discharged into the Sacramento River or reused as makeup water. Discharges during construction will be controlled until water meets discharge requirements specified by the RWQCB. Following construction, on-site discharges would be monitored and controlled by site operations according to RWQCB requirements (i.e., an NPDES discharge permit). Significant impacts to water quality in the surrounding bay and river surface waters are not expected.

Low permeability sediments generally overlie shallow groundwater on the site. The potential for infiltration of leachate and pore water from the dredged materials to groundwater and transported to Suisun Bay and Sacramento River is negligible.

3.2.5 Alternative B3 (Ocean/Leonard Ranch/Redwood Landfill/Sonoma Baylands)

Biology

This alternative would require most of the capacity of the Sonoma Baylands and Leonard Ranch/Redwood Landfill sites, and impacts would be essentially as determined in Chapter 4 of the SEIR/S.

At the Sonoma Baylands site, 56.3 acres of seasonal freshwater and brackish wetlands would be filled. The restoration of tidal action may ultimately result in 289 acres of salt marsh wetland and the Coastal Conservancy's proposal to include the creation of 24 acres of seasonal wetlands on the site, a substantial beneficial impact. Site construction and disposal operations noise may adversely affect sensitive bird species (e.g., the California clapper rail, a state-listed threatened species) nesting in the salt marsh along San Pablo Bay, if and where these species occur.

Use of the Leonard Ranch/Redwood Landfill site under this alternative would result in the filling of 45 acres of seasonally inundated marshlands and 2 acres of ditches that presently contain freshwater wetland and aquatic habitats. Sensitive bird species nest in the salt marsh bordering San Pablo Bay and these species, if and where present, could be adversely affected by noise and activity associated with site construction and dredge disposal.

Water Quality

After the addition of dredged material at the Leonard Ranch/Redwood Landfill, on-site runoff will be altered to flow to a single point of discharge at an existing 30-inch corrugated metal pipe (CMP) on the southern property boundary (see Figure 3.2.4.4-4 of the SEIR/S). This CMP will direct the on-site surface drainage and the decant and effluent water into the existing perimeter channel that drains toward the existing pump station in the southwestern corner of the adjacent Sonoma Baylands site. This pumping station, located at the terminus of the channel, discharges flow through a pipe into the Petaluma River. The project design will eliminate any potential impacts from the release of elutriate water into San Pablo Bay because discharges to adjacent surface waters will be controlled by site operations until the on-site waters meet discharge standards. Additionally, preservation and maintenance of the existing levees and dikes surrounding the site will protect project operations from having significant impacts on the flooding potential of the area. No significant impacts to water quality from Leonard Ranch/Redwood Landfill surface water to San Pablo Bay are anticipated.

Shallow groundwater at the Leonard Ranch/Redwood Landfill in this area is generally saline. The dredged material is isolated from deeper, possibly higher quality groundwater aquifer by a layer of impermeable bay mud. Contaminants are not expected to impact the deeper aquifer. Impacts to San Pablo Bay water quality from groundwater is not expected.

The entire Sonoma Baylands site will be filled by levee/peninsula materials regraded from the site and dredged materials from the Port of Oakland. Existing interior drainage features will initially be altered by site regrading and the construction of perimeter levees to contain the dredged material. On-site

discharges will be controlled by site operations. Releases of decanted water from the dredge slurry placed on site will be controlled by spillways at three locations in the existing outer levee. Discharges during construction will be controlled until water meets RWQCB discharge requirements. Make-up water from the mouth of the Petaluma River will provide most of the effluent (80 to 85 percent of the incoming slurry), the expected salt concentration in the effluent will be similar to the nearby discharge point in San Pablo Bay, even with salt contributions from the dredged sediment. No additional mitigation measures will be required to supplement the project design conditions specified in the Sonoma Baylands RWQCB permit. No significant impact from surface water to San Pablo Bay is expected.

Because essentially impermeable bay muds underlie the site at Sonoma Baylands, the potential for infiltration of leachate and pore water from the dredged material, and subsequent transport to the bay via groundwater is not considered a significant adverse impact.

Sediment

Releases of decanted water at the Sonoma Baylands site from the dredge slurry placed on site will be controlled by spillways at three locations in the existing outer levee. Discharges through the spillways will be monitored to ensure that sufficient retention time occurs for fine-grained particulates to settle out. Using stockpiled topsoil from the existing hay fields on the levees and peninsulas above the marsh plain fill will hasten the reestablishment of vegetation, thereby minimizing erosion and sedimentation during construction. Adherence to NPDES erosion and sedimentation controls and BMPs during site construction, in combination with the containment berms and revegetation incorporated into the site design, will eliminate potentially significant impacts of increased sedimentation into adjacent surface waters.

3.2.6 Alternative C1 (Montezuma Wetlands/Galbraith Golf Course)

Biology

Under this alternative, approximately 6.4 mcy would be disposed at the Montezuma Wetlands site. This is 28 percent of the total capacity of the Montezuma Wetlands Project as proposed (Solano County 1993). Hence, Port of Oakland's use of this site would contribute substantially to the impacts identified for the development of the Montezuma Wetlands Project as a whole (Solano County 1993). These impacts include the loss or modification of approximately 1,600 acres of wetland habitat, which, as a result of project design, may be converted to alternative types of wetland and aquatic habitats. Leaching or plant uptake of contaminants in dredge spoils may allow these contaminants to enter the food chain and potentially affect sensitive wildlife species, including state- and federally protected fish and migratory bird species. Losses of habitat and population may occur for a number of sensitive, plant and wildlife species on the site; these impacts remain to be defined. The Montezuma Wetlands Project would eliminate approximately 524 acres of habitat for the salt marsh harvest mouse, a federally listed endangered species.

The alternative would entail disposal of approximately 200,000 cy at the Galbraith Golf Course site. At the Galbraith site, land clearing, construction of perimeter levees, and discharge of dredged materials into cells will result in the loss of approximately 3.7 acres of seasonal wetlands, tidal wetlands, and other waters of the United States (exact acreage to be determined by the Corps). Unavoidable loss of wetlands at the Galbraith site would be mitigated by creation of compensatory on-site wetlands at a ratio of 1.1:1 to 1.3:1 on an acreage basis. The site provides potentially suitable habitat for special-status taxa reported

to occur in the area, including burrowing owl (see Table C-2 in Appendix C). Dewatering areas may attract shorebirds and waterfowl, and additional bird activity increases the potential risk of bird-aircraft collision. Excessive noise from the site preparation activities, operation of the unloading station, and booster pumps may also interfere with wildlife behavior. In addition, the potential infiltration of saline pore water and slurry make-up water may impact the relatively fresh groundwater (TDS < 3000 mg/l) at this site.

Water Quality

At the Montezuma Wetlands site, disposal of sediments meeting the state criteria for use as cover material in wetlands creation would be expected to result in no significant impacts on surface water and groundwater quality, with the exception of salt. For disposal of sediments that would be used as non-cover material at the site, significant impacts on groundwater and surface water quality, while not expected, could possibly occur, due to the release of salt, metals, tributyltin, and total PAHs.

Upland disposal at the Galbraith site could result in significant impacts on surface water and groundwater quality from the release of salt, metals, tributyltin, and total PAHs, although such impacts are not expected.

Sediment

Using stockpiled topsoil from existing degraded marshland on the Montezuma Wetlands site will hasten the reestablishment of vegetation, thereby minimizing erosion and sedimentation during construction. Adherence to NPDES erosion and sedimentation controls and BMPs during site construction and operation, in combination with the containment levees and revegetation incorporated into the site design, would eliminate potentially significant releases of particulates in effluent and runoff. Disposal of sediments meeting the state criteria for use as cover and non-cover materials in wetlands creation would not be expected to result in significant impacts to the Sacramento River or Suisun Bay.

3.2.7 Alternative C2 (Montezuma Wetlands/Leonard Ranch/Redwood Landfill)

Biology

Under this alternative, approximately 6.4 mcy would be disposed at the Montezuma Wetlands site. This is 28 percent of the total capacity of the Montezuma Wetlands Project as proposed (Solano County 1993). Hence, Port of Oakland's use of this site would contribute substantially to the impacts identified for the development of the Montezuma Wetlands Project as a whole (Solano County 1993). These impacts include the loss or modification of approximately 1,600 acres of wetland habitat, which, as a result of project design, may be converted to alternative types of wetland and aquatic habitats. Leaching or plant uptake of contaminants in dredge spoils may allow these contaminants to enter the food chain and potentially affect sensitive wildlife species, including state- and federally protected fish and migratory bird species. Losses of habitat and population may occur for a number of sensitive, plant and wildlife species on the site; these impacts remain to be defined. The Montezuma Wetlands Project would eliminate approximately 524 acres of habitat for the salt marsh harvest mouse, a federally listed endangered species. These impacts would undoubtedly be diminished or offset through mitigation before the Montezuma Wetlands Project were implemented and made available for use by the Port of Oakland.

Use of the Leonard Ranch/Redwood Landfill site under this alternative would entail disposal of 200,000 cy, and impacts would be reduced relative to the analysis in Chapter 4. Some loss of wetland habitat, comprising seasonally inundated marshlands and ditches, would still be likely and require mitigation. Noise and disturbance impacts on sensitive bird species that nest in the salt marsh bordering San Pablo Bay would be potentially significant, but these impacts would be more readily avoided under this alternative than under other alternatives that require use of most or all of this site's capacity.

Water Quality

At the Montezuma Wetlands site, disposal of sediments meeting the state criteria for use as cover material in wetlands creation would be expected to result in no significant impacts on surface water and groundwater quality, with the exception of salt. For disposal of sediments that would be used as non-cover material at the site, significant impacts on groundwater and surface water quality, while not expected, could possibly occur, due to the release of salt, metals, tributyltin, and total PAHs.

The Leonard Ranch site could result in significant impacts on surface and groundwater from the release of salt, metals, tributyltin, and total PAHs although such impacts are unlikely.

Sediment

Using stockpiled topsoil from existing degraded marshland on the Montezuma Wetlands site will hasten the reestablishment of vegetation, thereby minimizing erosion and sedimentation during construction. Adherence to NPDES erosion and sedimentation controls and BMPs during site construction and operation, in combination with the containment levees and revegetation incorporated into the site design, would eliminate potentially significant releases of particulates in effluent and runoff. Disposal of sediments meeting the state criteria for use as cover and non-cover materials in wetlands creation would not be expected to result in significant impacts to the Sacramento River or Suisun Bay.

3.2.8 Alternative D1 (Borrow Area only)

Marine Biology

According to the Maximum Confined Aquatic Disposal alternative, approximately 1.8 mcy of unsuitable dredged material for aquatic disposal (as determined by sediment chemistry, toxicity testing, and bioaccumulation tests) would be disposed at the Bay Farm Borrow Area and capped with a maximum of 4.8 mcy of suitable material dredged from Oakland Harbor. The potential impacts of this alternative are assessed more fully in section 4.4 of the SEIR/S. Physical effects on the biota as a result of increased turbidity (e.g., clogged gills and feeding appendages, reduced dissolved oxygen in the water column, and decreased primary production) are expected to be insignificant. Increased turbidity could affect eggs or activities of fish which may spawn in eelgrass beds southeast of the borrow area, such as herring. However, if measures are taken to minimize turbidity or disposal is avoided during spawning periods (e.g., December through February for herring), effects of turbidity are expected to be insignificant.

The benthic infauna existing in the disposal target zone (the borrow pit) are not expected to survive, although more motile species such as fish and crabs could escape from the site during disposal operations. If dredged material is placed periodically at the site, the benthic community which recolonizes the site is expected to consist primarily of opportunistic species. Once cap placement is complete, the community

which develops would likely consist of species which currently exist at the site and those found in sandier regions adjacent to the pit. Because most of the fish, crab, and shrimp species found within the borrow pit were also present in regions surrounding the pit, loss of the current borrow pit habitat is not expected to be significant to the fish community occurring in the vicinity of the disposal site. Similarly, impacts on birds and mammals (including threatened and endangered species) such as a temporary reduction in prey at the release site are expected insignificant.

The design of disposal at the BFBA calls for disposing the unsuitable material in cells (smaller subsections of the borrow pit). The unsuitable material will be continually disposed within the cell for up to a period of a month, after which it will be immediately capped with a layer of suitable material approximately 30-50 cm thick. Other cells will then be filled in the same manner until all are filled or the dredging project is complete (up to two years of operations). Thus, the initial cell caps may remain exposed, relatively undisturbed (depending on the proximity of cells being filled), and available for recolonization for a period of up to two years. Once all the cells are filled, a final thick cap will be placed over all the cells.

During the period in which unsuitable material is disposed in a particular cell, no recolonization is expected to occur as the area will be continually disturbed by the disposal operations. Thus, an infaunal community that would be directly exposed and potentially bioaccumulating the contaminated material would not develop. An opportunistic community (colonized by species found in the areas surrounding the borrow pit) may develop on the initial cap layer within weeks to months (depending on the level of disturbance caused by disposal operations in adjacent cells). Some of these may be available as a food source to various epibenthic organisms and small fish. If the cell remains undisturbed for up to two years, some deeper dwelling organisms may be established at the site, who could potentially burrow down to the unsuitable material. However, this is not likely, as deep-burrowing species were not part of the benthic community inhabiting the pit documented by investigations of the BFBA prior to disposal.

If despite the low probability of their occurrence, large deep-burrowing infauna did establish themselves on the cap within two years, it is expected that the availability of these organisms as a food source for fish typically found at the BFBA would be low. Additionally, the level of bioturbation and intrusion of unsuitable material into the cap layer during this period is not expected to be high enough to be significantly bioavailable to the benthic infauna or predators of these organisms. Once the final cap layer is placed, the layer should be thick enough (approximately 6 feet) to isolate the unsuitable material from the community that eventually recolonizes the site, so that bioaccumulation of contaminants is not expected to occur.

Impacts to the fish community such as bioaccumulation of contaminants and various sublethal effects particularly in smaller fish and juveniles, is not expected to be significant if the unsuitable material is immediately capped following continual disposal over a period of a month, according to the current disposal plan. Physical and toxic effects as a result of increased suspended sediments are expected to be localized and minimal. Once the cap is in place and contaminants contained, recolonization of prey species is expected to be relatively rapid, so that long-term impacts of disposal on the fish community are expected to be insignificant.

Water Quality

The maximum volume of dredged material found unsuitable for unconfined, open-water disposal is 1.8 mcy. This sediment would be placed at the BFBA where it would be completely covered by 4.8 mcy of

"clean" material deemed suitable for unconfined, open-water disposal under the CWA and PN 93-2. This disposal scenario and its potential water column impacts have been discussed in detail in section 4.2. Using dispersion modeling, it was predicted that at no time would the concentration of dredged material exceed 0.315 percent in the water column. Both the suitable and unsuitable materials were found to be in compliance with the LPC of 0.315 percent; and, therefore, water quality objectives of the RWQCB in terms of toxicity will be achieved. However, dissolved oxygen concentrations may be depleted during disposal operations to levels below the minimum 5.0 mg/L standard set by the RWQCB. This effect will be localized and short term. Moreover, the placement of cap material using controlled submerged pipeline may reduce oxygen depletion effects. Alternatives in other water quality variables will also be localized and ephemeral. As such, significant impacts to the water column are not expected.

Sediment

In this CAD scenario, sediments found unsuitable for in-Bay disposal will be placed in the BFBA and capped with "suitable" sediments. Ambient BFBA sediments will, unavoidably, be degraded by the addition of contaminated sediments. Impacts to sediment quality will be limited to the period of time they remain uncapped. Sediment impacts *per se* are not expected to be significant because capping will effectively isolate contaminant release. The cap material will improve the quality of sediments placed there (i.e., unsuitable materials), and for some parameters, will actually improve the quality of pre-disposal BFBA sediments. The assessment of significant impacts to sediment quality under this scenario hinges on the amount of exposure time between contaminated sediment placement and cap placement and the cap design itself. Presently, capping activities will take place after all unsuitable material has been placed. The cap has a life expectancy of 50 years, at which time additional management actions would be taken. Assuming cap placement is successful in confining the contaminated sediments (thereby minimizing contaminant release), no significant long-term impacts to sediment quality are expected. Implications as to the timing of cap placement are discussed in the biological resources section, G.4.4.

3.2.9 Alternative E1 (Ocean/Alcatraz/Galbraith Golf Course)

Marine Biology

Alternative E1 calls for approximately 4.8 mcy at the Alcatraz disposal site. Impacts to the biological community at the disposal sites would not be significant. Impacts that would occur for maximum disposal (4.8 mcy of dredged material) at the Alcatraz site are addressed in section 4.4 of the SEIR/S. Physical impacts as a result of increased turbidity are expected to be minimal and localized for all the organisms present, and should last only until the dredge plume dissipates. Because dredged material has been disposed periodically at the Alcatraz site, the benthic community at the site is characterized by species adapted to disturbance, and is expected to recover rapidly subsequent to disposal. Fish, birds, crabs, and marine mammals are highly mobile, and should be able to avoid the dredge plume, so that impacts on these species are not expected to be significant. In order to diminish chances of impacts on species migrating through the site (e.g., Dungeness crabs, winter-run chinook salmon, and striped bass), disposal during periods when the species are not migrating (e.g., summer) would minimize potential impacts on these species. Additionally, disposal during ebb tide would help flush suspended particulates out of the Bay and not farther into the bay, so that effects on water column biota would be further reduced.

Only sediments determined as suitable for in-Bay disposal would be released at the site. Therefore, no significant toxic effects on the various biota are not expected to occur. Bioaccumulation of some

chemicals (e.g., PAHs and metals) may occur in some of the benthic infauna, although levels would be minor. These chemicals are not expected to biomagnify in higher trophic levels such as fish birds and mammals.

Biology

At the Galbraith site, land clearing, construction of perimeter levees, and discharge of dredged materials into cells will result in the loss of approximately 3.7 acres of seasonal wetlands, tidal wetlands, and other waters of the United States (exact acreage to be determined by the Corps). Unavoidable loss of wetlands at the Galbraith site would be mitigated by creation of compensatory on-site wetlands at a ratio of 1.1:1 to 1.3:1 on an acreage basis. The site provides potentially suitable habitat for special-status taxa reported to occur in the area, including burrowing owl (see Table C-2 in Appendix C). Dewatering areas may attract shorebirds and waterfowl, and additional bird activity increases the potential risk of bird-aircraft collision. Excessive noise from the site preparation activities, operation of the unloading station, and booster pumps may also interfere with wildlife behavior. In addition, the potential infiltration of saline pore water and slurry make-up water may impact the relatively fresh groundwater (TDS < 3000 mg/l) at this site.

Water Quality

This alternative includes the disposal of 4.8 mcy of "suitable" dredged material at the Alcatraz disposal site. Potential impacts associated with material disposal at Alcatraz has been discussed in section 4.2, where the discussions assume maximum volume disposal at the Alcatraz disposal site. Disposal at Alcatraz will be carefully managed by the Corps to comply with target 30-day disposal volumes. These controls will extend the dredging period of performance if maximum use of Alcatraz is exercised. Alterations to water quality parameters (with the exception of suspended solids) are expected to be short-term (less than 3 minutes during each disposal event) and near field. Total suspended solids have been measured in the field in the past at Alcatraz, where concentrations of 165 mg/L or less have been recorded, and disposal plumes typically dissipate within 30 minutes of release. Only materials in compliance with LPC requirements will be discharged at the Alcatraz disposal site. Criteria set by the RWQCB for conventional parameters and toxicity are expected to be achieved (see section 4.2).

Contributions of suspended solids caused by disposal operations at Alcatraz could reach 1.83 mcy using the predictions of Teeter (1987). Up to half of this volume could leave the Bay through the Golden Gate. In comparison to Bay-wide contributors to sediment load, the Alcatraz alternative is very small. The largest contributor to sediment load in the Bay annually is resuspended sediment (160 mcy) and the Delta region provides another 8.0 to 10.5 mcy on an annual basis (PTI 1989). Based on this evidence, water column impacts at the Alcatraz disposal site are expected to be insignificant. This assessment does not include impacts associated with high frequencies of disposal events since these data are not available.

Sediment

This alternative involves use the Alcatraz disposal site. Potential consequences to sediment quality as a result of disposal activities at Alcatraz are discussed in section 4.3.4.2 of the SEIR/S and represent a worst-case-scenario in terms of maximum disposal volumes. Materials proposed for disposal at Alcatraz have passed testing requirements under the CWA and PN 93-2, precluding significant impacts to sediment quality. Moreover, historical use of Alcatraz has resulted in an extremely heterogeneous substrate. The

site displays substantial disturbance by virtue of the high rate of disposal activity occurring there. Disposal of materials deemed suitable for unconfined, open-water disposal may improve sediment quality at Alcatraz overall. Implementation of the Corps' 30-day volume targets is essential to avoid excessive accumulations of sediment that could, if not managed carefully, result in a navigation hazard. No significant impacts to sediment quality are expected at the Alcatraz disposal site for this project.

3.2.10 Alternative E2 (Ocean/Borrow Area/Galbraith Golf Course)

Marine Biology

According to Alternative E2, Oakland Harbor material determined to be suitable for aquatic disposal, will be disposed at the Bay Farm Borrow Area site (4.8 mcy). Conditions occurring once the cap is in place, as described in section 4.4 are representative of those that would occur for Alternative E2 at the borrow pit. Because the material is considered suitable, no significant toxic effects on, bioaccumulation, and biomagnification in the biota are expected to occur. Recolonization of the Bay Farm site would be relatively rapid and consist of a mixture of organisms currently existing at the borrow pit and those existing in adjacent areas to the borrow pit. Fish, birds, mammals, and threatened and endangered species may be temporarily affected, but are not expected to be significantly impacted. Thus, no significant impacts on the biological communities existing at the disposal sites are expected to occur.

Wetland/Upland Biology

At the Galbraith site, land clearing, construction of perimeter levees, and discharge of dredged materials into cells will result in the loss of approximately 3.7 acres of seasonal wetlands, tidal wetlands, and other waters of the United States (exact acreage to be determined by the Corps). Unavoidable loss of wetlands at the Galbraith site would be mitigated by creation of compensatory on-site wetlands at a ratio of 1.1:1 to 1.3:1 on an acreage basis. The site provides potentially suitable habitat for special-status taxa reported to occur in the area, including burrowing owl (see Table C-2 in Appendix C). Dewatering areas may attract shorebirds and waterfowl, and additional bird activity increases the potential risk of bird-aircraft collision. Excessive noise from the site preparation activities, operation of the unloading station, and booster pumps may also interfere with wildlife behavior. In addition, the potential infiltration of saline pore water and slurry make-up water may impact the relatively fresh groundwater (TDS < 3000 mg/l) at this site.

Water Quality

In this disposal scenario, the 4.8 mcy proposed for disposal at Alcatraz in section G.5.1.2 would be placed alternatively at the BFBA. The placement of 4.8 mcy of sediment at the BFBA has also been discussed under the CAD alternative (section G.4.2). The volume of material under this scenario is equivalent to the placement of cap material under the CAD alternative. As noted in the section G.4.2, predictions as to potential impacts to the water column have been modeled by the Corps. Based on their results, no significant water quality impacts in terms of toxic effects are expected during material disposal. With the exception of dissolved oxygen concentrations, water quality variables such as temperature, salinity, pH, and suspended solids, are not expected to change beyond those limits defined by RWQCB. Dissolved oxygen concentrations could decline below the minimum 5.0 mg/L requirement during disposal at certain times of the year. This effect would be localized and short-term. Significant impacts to the water quality, however, are not expected at the BFBA under this disposal scenario.

Sediment

The placement of 4.8 mcy of sediment at the BFBA, as discussed in the previous section, is equivalent to the placement of the capping material described in section G.4.3. The BFBA sediments show effects of anthropogenic input of certain containment constituents, and placement of materials deemed "suitable" for unconfined, open-water disposal will either maintain present sediment quality or improve it. No significant impacts to BFBA sediment quality under this alternative are expected.

3.2.11 Alternative E3 (Ocean/Alcatraz/Leonard Ranch/Redwood Landfill)

Marine Biology

For the Alternative E3 disposal plan, the quantity and proportions of dredged material to be disposed at the Alcatraz and ocean disposal sites are the same as those delineated in Alternative E1. As described above, only suitable Oakland Harbor sediments will be disposed at this site. Impacts to the biota occurring at the Alcatraz site are not expected to be significant.

Wetland/Upland Biology

Use of the Leonard Ranch/Redwood Landfill site under this alternative would result in the filling of 45 acres of seasonally inundated marshlands and 2 acres of ditches that presently contain freshwater wetland and aquatic habitats. Sensitive bird species nest in the salt marsh bordering San Pablo Bay and these species, if and where present, could be adversely affected by noise and activity associated with site construction and dredge disposal.

Water Quality

The decision to use this disposal alternative would result in no significant impacts to Alcatraz waters. The volumes of material proposed for disposal under this scenario are 4.8 mcy at Alcatraz. Potential impacts to the water column caused by the disposal of this proposed volume of material was discussed in section G.5.1.2.

Sediment

For reasons described in section G.5.1.3 of the SEIR/S, no significant impacts to sediment quality at the Alcatraz disposal site are anticipated based on the proposed disposal volumes (4.8 mcy).

3.2.12 Alternative E4 (Ocean/Borrow Area/Leonard Ranch/Redwood Landfill)

Marine Biology

The amount of material to be disposed at the Bay Farm Borrow Area in Alternative E4, is the same quantity as described for Alternative E2. As described in section G.5.1.4, impacts on the biological community are expected to be insignificant.

Wetland/Upland Biology

Use of the Leonard Ranch/Redwood Landfill site under this alternative would result in the filling of 45 acres of seasonally inundated marshlands and 2 acres of ditches that presently contain freshwater wetland and aquatic habitats. Sensitive bird species nest in the salt marsh bordering San Pablo Bay and these species, if and where present, could be adversely affected by noise and activity associated with site construction and dredge disposal.

Water Quality

The potential impacts associated with maximum discharge of materials at unconfined disposal sites at the BFBA have been discussed in sections G.5.1.2 and G.5.2.3. Proposed material volumes for disposal are 4.8 mcy. No significant impacts to site waters are expected (see section G.5.2.2).

Sediment

Impacts to sediment quality at the BFBA are not expected to be significant under this disposal scenario (4.8 mcy at the BFBA). Sediment quality will either be maintained in its present condition or improved (see section G.5.2.3).

3.2.13 Comparison of the Impacts of All Alternatives on the Aquatic Environment

Alternative B2 is considered to have the least impact of all the practicable alternatives on the aquatic environment. The No-Action Alternative is not considered practicable because of the resulting adverse effects on the movement of goods and the economy of the San Francisco Bay area and the nation, as described in section 2.3 of the SEIR/S.

The principal reason that Alternative B2 is considered to have the least adverse impacts on the aquatic environment is that it avoids disposal at in-Bay sites and includes restoration of wetlands at the Sonoma Baylands site. All of the other practicable alternatives entail (a) disposal at in-Bay sites; (b) elimination of wetlands sites; or (c) both a and b. Disposal of dredged material at any of the sites under consideration will have adverse environmental impacts.

It should be noted that Alternative B2 includes placement of 1.2 mcy of material unsuitable for aquatic disposal at the Galbraith Golf Course site, with potential adverse effects on water quality and adjacent aquatic habitat. However, this potential impact is considered less important when considering the advantage to the aquatic environment in general of disposing of the bulk of the dredged material at the Sonoma Baylands site, which will result in a beneficial impact from restoration of wetlands.

The project's impact on wetlands has been minimized by avoiding wetland areas to the maximum extent practicable. In an effort to avoid wetland areas, a range of disposal options were evaluated for sediments that are considered unsuitable for aquatic disposal (see Table 2.7-1). Since none of the other disposal options are currently feasible, the Galbraith site was selected. Wetland impacts at Galbraith would be minimized to the extent feasible by avoiding some wetland areas. However, 3.7 acres of the on-site wetland areas could not be avoided while still providing sufficient capacity to retain and dry the dredged sediments (e.g., avoidance of the drainage channel, a wetland area located in the center of the golf course, would substantially reduce the site's capacity of dredged sediments and thus greatly increase

project costs). For the wetland areas that cannot be avoided, compensatory on-site mitigation at a ratio of 1:1:1 to 1:3:1 on an acreage basis would be implemented. The final ratio will be determined once the design of the mitigation areas is finalized and permitted. The variance depends on the design of the wetland edge and buffer areas since the absolute acreage available is limited by two factors: (1) Federal Aviation Administration regulations regarding creation of features to attract wildlife within the runway protection zones, and (2) the limited acreage of undeveloped upland areas within the Metropolitan Oakland International Airport. The proposed mitigation areas will be designed to provide greater habitat value than the existing wetlands that would be replaced because they will be contiguous and maintained. This would mitigate wetland impacts at Galbraith to a less than significant level.

3.3 COMPLIANCE WITH APPLICABLE STATE WATER QUALITY STANDARDS

The proposed project will comply with State of California Water Quality Standards. The sediment sampling, testing, and test results were closely coordinated with all appropriate federal and state agencies (e.g., EPA and the RWQCB). Thus there is a substantial basis that the project complies with State water quality standards and that it is expected to receive the required certification.

3.4 COMPLIANCE WITH APPLICABLE TOXIC EFFLUENT STANDARD OR PROHIBITION UNDER SECTION 307 OF THE CLEAN WATER ACT

Effluent guidelines under Section 307 of the Clean Water Act have not been promulgated for dredged material.

3.5 COMPLIANCE WITH ENDANGERED SPECIES ACT OF 1973

The proposed action would be in compliance with the Endangered Species Act of 1973. The U.S. Fish and Wildlife Service's letter dated May 19, 1994 concurs that the preferred alternative B2 is not likely to adversely affect federally listed threatened and endangered species.

3.6 COMPLIANCE WITH SPECIFIED PROTECTION MEASURES FOR MARINE SANCTUARIES DESIGNATED BY THE MARINE PROTECTION, RESEARCH AND SANCTUARIES ACT OF 1972

The proposed action is not located within any marine sanctuary, nor is it expected to have adverse effects on any marine sanctuary.

3.7 EVALUATION OF EXTENT OF DEGRADATION OF THE WATERS OF THE UNITED STATES

Section 4 of the SEIR S provides a full analysis of the anticipated environmental impacts of the proposed action.

3.8 APPROPRIATE AND PRACTICAL STEPS TAKEN TO MINIMIZE POTENTIAL ADVERSE IMPACTS OF THE DISCHARGE ON THE AQUATIC ECOSYSTEM

Proposed mitigation measures for the significant impacts on the aquatic environment are described in the Mitigation Monitoring and Reporting Plan in Appendix J.

3.9 COMPLIANCE OF THE PROPOSED DISPOSAL SITE FOR THE DISCHARGE OF DREDGED MATERIAL

The proposed action complies with the requirement of the 404(b)(1) guidelines with the inclusion of appropriate and practical conditions to avoid, minimize, and/or mitigate adverse impacts to the aquatic ecosystem.

APPENDIX E2

COMPLIANCE OF THE PROPOSED ACTION WITH OCEAN DUMPING REGULATIONS

Title 40 of the Code of Federal Regulations (CFR), Subchapter H, Parts 220 through 229 establishes procedures and criteria to be applied by the Corps for the issuance of permits to transport dredged material for the purpose of dumping it in ocean waters pursuant to Section 103 of the Marine Protection, Research, and Sanctuaries Act (MPRSA). These criteria are based on those established for the issuance of permits by EPA under Section 102 of the MPRSA. This appendix evaluates the compliance of the proposed action with the criteria identified specifically in Parts 225, 227, and 228.

1.0 Compliance with Part 225 -- U.S. Army Corps of Engineers Dredged Material Permits

The project involves the proposed deepening of Oakland Harbor to accommodate deep-draft ships. The material proposed for disposal at the Section 102 site (herein referred to as the ocean site) (2.9 million cubic yards) has been tested according to EPA and Corps guidelines (EPA/COE 1991) and is deemed suitable for ocean disposal. The ocean site is currently being designated for use by the EPA under Section 102 of the MPRSA and no other feasible site has been designated for ocean disposal. The known historical uses of the ocean site include previous dumping of munitions at the site and new construction materials from Naval Air Station (NAS) Alameda and NSC Oakland.

2.0 Compliance with Part 227 -- Criteria for the Evaluation of Permit Applications for Ocean Dumping of Materials

Criteria used to evaluate ocean disposal of dredged material permit applications are provided in 40 CFR 227, Subparts B, C, D, and E. The disposal permit applications must demonstrate compliance with Subpart B Sections 227.4, 227.5, 227.6, 227.9, 227.10, and 227.13. Subparts C, D, E, and G must be complied with for Corps approval of disposal at the ocean site.

2.1 Subpart B -- Environmental Impact

Based on the site characterization studies and characterization of dredged material, disposal of Oakland Harbor dredged material tested and deemed suitable for disposal at the ocean site would not be expected to have unacceptable adverse effects on human health or the ocean (40 CFR 227.4). The disposal would not have unacceptable effects on the marine ecosystem of the ocean site and vicinity.

Dredged material from Oakland Harbor does not contain materials prohibited for ocean disposal (40 CFR 227.5) at the ocean site. Prohibited materials for disposal include high-level radioactive wastes; materials produced or used for radiological, chemical or biological warfare; or persistent inert synthetic or natural material that may float or remain in suspension.

Only dredged material that has been tested according to the "Green Book" (EPA/COE, 1991) and approved protocols (Section 4.0) and deemed suitable for ocean disposal will be disposed of at the ocean site. PAHs and some metals are present only as trace contaminants in sediment otherwise suitable for ocean disposal (40 CFR 227.6). Elutriate chemistry tests demonstrated that chemical constituents in the dredged material would not exceed applicable marine water quality criteria after allowance for initial mixing. The results of liquid/suspended phase (LSP) bioassays with dredged material demonstrated that

toxicity thresholds, defined as 0.01 of the acutely toxic concentration, were not exceeded by estimated concentration of suspended particulate after allowance for initial mixing. Solid phase bioassays demonstrated that the potential for the dredged material to cause unreasonable acute and chronic toxicity was low. The bioaccumulation levels of contaminants of concern in bivalves in the 28-day bioaccumulation studies did not exceed FDA action levels and did not exceed the LPC for benthic bioavailability.

The total quantity of dredged material proposed for disposal at the ocean site, approximately 2.9 million cy (mcy), would be disposed of over a 16 to 19 month period. Sediment footprint modeling was performed for two release quantities, 1.6 mcy and 6.6 mcy, over a one-year period. For the 1.6 mcy release, the model estimated a maximum thickness of 26.9 cm. For the 6.6 mcy release, the model estimated a maximum thickness of 49 cm. Since 2.9 mcy would go to the ocean site under the proposed project, the deposit thickness would likely be somewhere between 26.9 cm and 49 cm. In either case modeled, the result would likely be the burial of the dominant species, a surface deposit feeder, and slow moving epifaunal invertebrates but, overall, there would be little impact on mobile and burrowing organisms (40 CFR 227.9).

Disposal of dredged material at the ocean site would not pose a hazard to fishing, navigation, shorelines, or beaches (40 CFR 227.10). The ocean site contains no significant commercial or recreational fisheries, and no critical fisheries habitats have been identified in the area. Sportfishing and marine recreation activities occur to the east of the ocean site in the Gulf of the Farallones National Marine Sanctuary (GFNMS). Fishing activities in general occur predominantly at shallower depths than the ocean site, less than 1,000 m, and are located over 10 nmi east of the ocean site. Dredged material disposal at the ocean site would not pose a hazard to navigation. San Francisco Bay is a major international harbor, and maritime commerce is an important part of the Bay Area economy. The ocean site is located far from the path of the two most active shipping lanes, the northern and southern shipping lanes going into and out of the bay. Site-specific data indicate that ship traffic remains outside of a 10-nmi radius around the ocean site. This will be a sufficient boundary to not affect navigation. Disposal of dredged material at the ocean site is not expected to impact shorelines or beaches. The ocean site is located approximately 5 nmi west of the western boundary of the GFNMS and approximately 22 nmi southwest of the Farallon Islands. The southern boundary of the Cordell Bank National Marine Sanctuary is 8 nmi north of the ocean site. The closest beaches are Drakes Bay, approximately 29.6 nmi northeast of the site, and Stinson Beach, approximately 24 nmi northeast of the ocean site. Sediment dispersion modeling results indicate that the concentration of suspended sediments will be reduced to ambient concentrations rapidly after disposal.

Dredged material from Oakland Harbor is composed predominantly of silt and clay-sized particles and, therefore, is not excluded from further testing as defined in 40 CFR 227.13. LSP and solid phase bioassays were conducted and demonstrated that the dredged material after allowance for initial mixing would not exceed applicable marine water quality criteria and would not be expected to cause unreasonable acute or chronic toxicity, sublethal adverse effects, or cause accumulation of toxic materials in the human food chain (40 CFR 227.13).

2.2 Subpart C -- Need for Ocean Dumping

Ocean disposal of dredged material along with wetlands restoration and landfill disposal were determined (collectively) as the most environmentally protective alternative after a comprehensive alternatives analysis

(227.14) conducted by the Corps/Port of Oakland (see Appendix E1). The Corps and Port of Oakland evaluated several alternatives for disposal of the dredged material including in-bay disposal, upland disposal, and ocean disposal. The need for a combination of ocean dumping and other disposal options was established in the SEIR/S, and the preferred disposal alternative was identified (see Chapter 7).

Dredged material is produced by natural sedimentological processes but anthropogenic activities contribute to concentrations of toxic substances in sediments. The material to be dredged from Oakland Harbor was tested in accordance with Parts 227.6 and 227.32 to determine its suitability for ocean disposal. A regional regulatory decision and approval for ocean disposal is required. Dredged material volume of approximately 2.9 million cy is too large to be stored (227.15).

2.3 Subpart D -- Impact of the Proposed Dumping on Aesthetic, Recreational, and Economic Values

The Corps/Port of Oakland evaluated the impact of the Oakland Harbor project through environmental impact statements. This SEIR/S specifically evaluates the impacts of the proposed disposal of dredged material at the ocean site. Recreational and commercial fishing are virtually non-existent at the site. Dredged material disposal will not exceed applicable marine water quality criteria (MWQC) standards after allowance for initial mixing. Because of the distance of the ocean site from shore and the lack of significant recreational or commercial fishing, as well as transportation routes, in the vicinity, no impacts are expected from disposal at the ocean site on aesthetic, recreational, or economic values.

2.4 Subpart E -- Impact of the Proposed Dumping on Other Uses of the Ocean

The ocean site is located far from estuarine and coastal areas, shorelines, and beaches employed for recreational activities. The principal uses of the ocean in the vicinity of the ocean site are transportation and, to a very limited extent, fishing. Disposal of dredged material at the ocean site is not expected to affect either activity. Commercial and recreational fishing are not found at the ocean site because of the depth of the site (2,900 m) and because fishermen avoid the former CMDA. The three shipping lanes controlling the entrance and exit to San Francisco Bay are approximately 25 nmi north, 20 nmi west, and 40 nmi south of the ocean site. Because the ocean site is not in the area used by fishermen or shippers, disposal operations are not expected to affect either activity. No other potential uses of the ocean in the vicinity of the ocean site have been identified.

APPENDIX F

Visual Analysis

(bound separately; limited distribution)

APPENDIX G

Detailed Project Alternatives Analysis

APPENDIX G

DETAILED PROJECT ALTERNATIVES ANALYSIS

Note: Detailed emission and equipment usage data associated with each project alternative are contained in Appendix B.

G.1 MAXIMUM OCEAN DISPOSAL

G.1.1 Alternative A1 (Ocean and Galbraith)

G.1.1.1 Air Quality

Summaries of daily and total emissions that would occur from Alternative A1 are provided in tables B-23 and -39, respectively. Project emissions would occur in Alameda and San Francisco counties. As shown in Table B-23, daily project emissions of NO_x would exceed one percent of the combined emissions from these two counties. Additionally, project emissions would exceed the daily Best Available Control Technology (BACT) trigger levels for all pollutants. These emissions would therefore be significant.

Project emissions would be spread over a large portion of the Bay Area region, between the Oakland Harbor, Galbraith Golf Course, and offshore waters. However, since project emission sources would be mobile, pollutant impacts would not be large enough in a localized area to exceed any ambient air quality standard.

Project emissions would exceed AQMD significance thresholds for all pollutants. Mitigation measures identified in section 4.1.4.1 were evaluated to determine if they would reduce project emissions to insignificance. However, due to feasibility, only the reduction in project NO_x, SO₂, and TOG/ROG emissions due to the implementation of 2-degree injection timing retard and reformulated diesel fuel was analyzed. Although electrification of diesel-powered dredges and pumps would eliminate a substantial amount of project emissions, this measure was deemed infeasible. Tables B-23 and -39 show that implementation of the above-mentioned mitigation measures would decrease project emissions, but only SO₂ emissions would be reduced to insignificance.

G.1.1.2 Hydrology, Groundwater, and Water Quality

Potential water column impacts at the ocean disposal site under this alternative have been previously described in section 4.2, where impacts for maximum volume disposal (i.e., 5.4 mcy) were assessed. No significant impacts to the water column at the Ocean Section 102 site are expected under the maximum disposal volume scenario. Local and regional circulation patterns would not change, and alterations to existing water quality parameters would be localized and short-term during each disposal event. This volume of material disposed at the site is considered small with respect to the water column (i.e., the large volume of ocean water at the site).

Upland disposal at the Galbraith Golf Course site could potentially result in significant impacts on surface and groundwater quality, due to the release of salt, metals, tributyltin, and total PAHs, although such impacts are not expected.

G.1.1.3 Geology, Soils, and Seismicity

Potential sediment quality impacts associated with the disposal of 5.4 mcy of material at the ocean site have been fully described in section 4.3. In general, most metals and organic compounds concentrations in Oakland Harbor sediments are elevated with respect to Ocean Section 102 sediments. However, the material slated for potential disposal at the ocean site has passed the testing requirements of the MPRSA; no significant adverse impacts to aquatic life are therefore expected. Accumulation of dredged material and associated changes in sediment characteristics will be unavoidable, however, their impacts are not considered significant. Dredged material would be placed in thin layers, and the deposit would approach background conventional and contaminant levels due to natural sedimentation over the long term. Consequently, if the maximum volume of material presently budgeted for disposal at the ocean site is deposited, impacts to sediment quality would not be considered significant.

Potentially significant seismic impacts could occur at the Galbraith Golf Course site, if a large magnitude earthquake occurred on a nearby fault. In such an event, severe ground motion and liquefaction could occur. Earthquake-induced levee failure at the site could cause geologic hazards on surrounding features such as Doolittle Drive, the interior drainage canal, and the San Leandro Wastewater Treatment Plant.

G.1.1.4 Biological Resources

Impacts to the biological community occurring at the ocean disposal site under Alternative A1 correspond to those described in section 4.4, in which impacts for the maximum ocean disposal of 5.4 mcy of dredged material were described. Potential impacts to the plankton community such as decreased productivity, growth, survival, and possible toxic effects are expected to be insignificant. Impacts to the benthic community due to burial and smothering of organisms are dependent on the amount of material deposited during each disposal event, the rate of accumulation and burial time, and the frequency of disposal. These impacts are expected to be localized, of short duration, and not significant. Most of the fish, birds, and marine mammals (including threatened and endangered species) at the ocean site are able to avoid the dredge plume so that the effects of the increased turbidity (e.g., reduced foraging efficiency, loss of foraging habitat, and alteration of passage routes) are expected to be localized and insignificant. Because only suitable material (as determined by sediment chemistry, SPP toxicity, SP acute toxicity, and bioaccumulation tests) would be disposed at this site, no significant biomagnification of contaminants or toxic effects on organisms occurring at the ocean site are expected to occur.

At the Galbraith site, approximately 3.7 acres of seasonal freshwater marsh, tidal wetlands, and other waters of the United States (exact acreage to be determined by the Corps) would be filled. Significant impacts would be mitigated at this site by compensatory on-site mitigation at a ratio of 1.1:1 to 1.3:1 (see section 4.4.5.6). Seasonal ponding at the Galbraith site may result in an increase in mosquitos. Consultation with the Alameda County Mosquito Abatement District is recommended to mitigate this impact. Aquatic biota may be disturbed by pipeline construction and pumping operations, and may potentially be impacted by fuel spills or a break in the slurry pipeline. These impacts may be mitigated by setting anchors for the duration of the project; careful handling of fuel; and installation of a leak detection system on the pipe and/or monitoring of the slurry discharge. There is a potential for significant impacts on burrowing owls, if present, a species of special concern. Impacts may be mitigated to insignificance by relocating any owls and active burrows identified during a pre-construction survey. Biological resource impacts at Galbraith are expected to be fully mitigable (see section 4.4.5.6).

G.1.1.5 Cultural Resources

No cultural resources are recorded in the ocean disposal site. The Galbraith Golf Course is on top of a former landfill so the likelihood of encountering intact cultural resources within this area is extremely low. No impacts on cultural resources are thus anticipated with this alternative.

G.1.1.6 Noise

Noise associated with use of the ocean disposal site would result from tugboats towing scows to the site. No noise impacts would result from disposing of dredge material at this site, since it is well removed from any sensitive receptors.

At the Galbraith site, the unloader and booster pumps could cause potentially significant impacts depending on their placement. Impacts could be mitigated to insignificance if the pumps were placed sufficiently far away from sensitive receptors.

G.1.1.7 Transportation

The ocean disposal site is located outside of designated commercial vessel traffic lanes and away from any restricted passage areas, precautionary zones, or anchorages for commercial shipping. Project tugboats would represent additional vessel traffic within the project area. However, in relation to the volume of traffic in the San Francisco Bay area, the increase would be minor, and no significant impacts would occur.

Transport of dredged sediments from Oakland Harbor to the Galbraith Golf Course would be via tug-pushed scows and pipeline from either San Leandro Bay (Option A) or San Francisco Bay (Option B). Because of the shallow waters near the San Leandro shoreline, the tug-drawn scows could only navigate within 3 miles of the drying pond site. An offloading station would be constructed in the Bay to allow unloading of the sediments via hydraulic pipeline floating on the Bay. Approximately 19,000 roundtrips would be generated over a four-month period by the transport of levee material to the site. The local roadways can accommodate this short-term increase in traffic, however, and impacts to vessel and ground transportation would be insignificant.

G.1.1.8 Land Use Plans and Policies

No land use impacts *per se* would result from use of the ocean disposal site. It is located in the waters of the United States and is not subject to local land use plans and policies. The U.S. EPA and the Corps share responsibility for the management of ocean disposal of dredged material. With concurrence from the EPA, the Corps issues permits under MPRSA Section 103 for ocean disposal of dredged material deemed suitable according to EPA criteria in MPRSA Section 102 and EPA regulations in 40 CFR Part 227. Ocean disposal sites must be evaluated using EPA's ocean dumping criteria in 40 CFR Part 228. The ocean disposal site under consideration in this document was evaluated and found to satisfy both the general and specific criteria established by the EPA (1992).

Land use impacts at the Galbraith Golf Course are potentially significant due to the interim 7-year loss of the golf course at the site and displacement of the municipal soccer field at the site. The City of Oakland will construct a new soccer field at the Curt Flood Sports Complex in East Oakland, which will

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mitigate potential impacts from loss of recreational use of the existing soccer field. Mitigation measures for the 7-year loss of the recreational use of the golf course will include development of a new golf course on site at the end of the 7-year interim construction phase, continuing the youth golfing program, and subsidizing the cost difference for Oakland resident seniors to play at other golf courses until the new golf course is available.

The ocean disposal site is located in an area where some commercial and recreational fishing occurs. Previous studies (EPA 1992) have indicated that impacts on commercial and recreational fishing would be insignificant due to the comparatively limited resources of the area, in addition to the fact that fish would avoid the disposal plumes. Since this disposal site lies outside of designated commercial shipping lanes, the increase in tugboat traffic would have no impact on commercial shipping.

G.1.2 Alternative A2 (Ocean and Leonard/Redwood)

G.1.2.1 Air Quality

Summaries of daily and total emissions that would occur from this alternative are provided in tables B-24 and -40, respectively. Project emissions would occur in Alameda, San Francisco, Sonoma, and Marin Counties. As shown in Table B-24, daily project emissions of NO_x would exceed one percent of the combined emissions from these counties. In addition, project emissions would exceed the daily BACT trigger levels for all pollutants. These emissions would therefore be significant.

Project emissions would be spread over a large portion of the Bay Area region, between the Oakland Harbor, Leonard Ranch and Redwood landfill, and offshore waters. However, since project emission sources would be mobile, pollutant impacts would not be large enough in a localized area to exceed any ambient air quality standard. Project emissions would exceed AQMD significance thresholds for all pollutants. The effect of implementing the mitigation measures identified in section 4.1.4.1 are presented in tables B-24 and -40. These show that mitigation measures would decrease project emissions, but only SO₂ emissions would be reduced to insignificance.

G.1.2.2 Hydrology, Groundwater, and Water Quality

This alternative maximizes disposal at the ocean disposal site and, for reasons described in section G.1.1.2, no significant impacts to site hydrodynamics and water quality conditions are expected.

Use of Leonard Ranch under this alternative would result in insignificant impacts on surface water and groundwater, due to the release of salt. No significant impacts on surface and groundwater are expected at Redwood Landfill, due to the requirements of the landfill's operating permits.

G.1.2.3 Geology, Soils, and Seismicity

Maximum disposal of dredged material at the ocean site would not cause significant adverse impacts to sediment quality, as explained in section G.1.1.3.

Potentially significant seismic impacts could occur at the Leonard Ranch site, if a large magnitude earthquake occurred on a nearby fault. In such an event, severe ground motion and liquefaction could

occur. Earthquake-induced levee failure at the site could cause geologic hazards on Highway 37 and the adjacent railroad tracks.

G.1.2.4 Biological Resources

Similar to Alternative A1, a maximum of 5.4 mcy would be disposed at the ocean disposal site under this alternative. Potential impacts at the ocean site would be identical to those described in sections 4.4 and G.1.1.4. Impacts to the biological community are expected to be localized, temporary, and insignificant.

Use of the Leonard Ranch/Redwood Landfill site under this alternative would result in the filling of 31 acres of seasonally inundated marshlands and 2 acres of ditches that presently contain freshwater wetland and aquatic habitats. Sensitive bird species nest in the salt marsh bordering San Pablo Bay and these species, if and where present, could be adversely affected by noise and activity associated with site construction and dredge disposal. These impacts are mitigable.

G.1.2.5 Cultural Resources

No cultural resources are recorded in the ocean disposal site. No cultural sites are recorded within the Leonard Ranch or Redwood Landfill sites. Because Leonard Ranch has not been surveyed, there is a potential for encountering cultural resources. Impacts on cultural resources are considered potentially significant with this alternative.

G.1.2.6 Noise

Noise associated with use of the ocean disposal site would result from tugboats towing scows to the site. No noise impacts would result from disposing of dredge material at this site, since it is well removed from any sensitive receptors.

No significant noise impacts would result from use of the Leonard Ranch or Redwood Landfill sites.

G.1.2.7 Transportation

The ocean disposal site is located outside of designated commercial vessel traffic lanes and away from any restricted passage areas, precautionary zones, or anchorages for commercial shipping. Project tugboats would represent additional vessel traffic within the project area. However, in relation to the volume of traffic in the San Francisco Bay area, the increase would be minor, and no significant impacts would occur.

Dredged material would be transported to the Leonard Ranch site by scows towed by tugs. The tugs would use navigable channels through San Pablo Bay to deliver sediments to a point in the mouth of the Petaluma River approximately 3,000 feet south of the Sonoma-Marin port. The increase in vessel trips would be consistent with established movements. The off-loading facility that would be constructed is located in a naturally wide and deep area and should not adversely affect local navigation.

Up to 1.2 mcy of dredged material could be dried at the Leonard Ranch site. The dried material would be transported to the Redwood Landfill. After the first year, material would be hauled by trucks. The project could increase the risk of accidents significantly on Landfill Road; additionally, increased traffic

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in the vicinity of the landfill would cause a significant impact. Mitigation measures such as avoiding peak hours and following an alternative route would reduce impacts to insignificance.

G.1.2.8 Land Use Plans and Policies

No land use impacts *per se* would result from use of the ocean disposal site. It is located in the waters of the United States and is not subject to local land use plans and policies. The U.S. EPA and the Corps share responsibility for the management of ocean disposal of dredged material. With concurrence from the EPA, the Corps issues permits under MPRSA Section 103 for ocean disposal of dredged material deemed suitable according to EPA criteria in MPRSA Section 102 and EPA regulations in 40 CFR Part 227. Ocean disposal sites must be evaluated using EPA's ocean dumping criteria in 40 CFR Part 228. The ocean disposal site under consideration in this document was evaluated and found to satisfy both the general and specific criteria established by the EPA (1992).

Much of the Leonard Ranch site is currently in agricultural production. The proposed rehandling facility at the Leonard Ranch site would result in the loss of about 215 acres currently in agricultural production on Leonard Ranch and the loss of an undetermined amount in the northernmost parcel. A financial analysis is in progress; no significant land use impacts from loss of agricultural land have been identified to date. The Sonoma County General Plan discourages the conversion of such lands to non-agricultural use, but provides that public uses may be approved if an overriding public benefit exists. The proposed rehandling facility would be inconsistent with the General Plan's policy unless it can be demonstrated that the facility would constitute an overriding public benefit. The project may also be inconsistent with General Plan scenic resources policies. Use of the site would not significantly impact nearby land uses. No land use policy conflicts are expected from use of the Redwood Landfill site.

The ocean disposal site is located in an area where some commercial and recreational fishing occurs. Previous studies (EPA 1992) have indicated that impacts on commercial and recreational fishing would be insignificant due to the comparatively limited resources of the area, in addition to the fact that fish would avoid the disposal plumes. Since this disposal site is located outside of designated commercial shipping lanes, the increase in tugboat traffic would have no impact on commercial shipping.

G.2 MAXIMUM WETLAND RESTORATION

G.2.1 Alternative B1 (Ocean, Montezuma Wetlands, and Port/Landfill)

G.2.1.1 Air Quality

Summaries of daily and total emissions that would occur from the alternative are provided in tables B-25 and -41, respectively. Project emissions would occur in Alameda, San Francisco, Contra Costa, and Solano Counties. As shown in Table B-25, daily project emissions of NO_x would exceed one percent of the combined emissions from these counties. In addition, project emissions would exceed the daily BACT trigger levels for all pollutants. These emissions would therefore be significant.

Project emissions would be spread over a large portion of the Bay Area region, between the Oakland Harbor, the Montezuma Wetlands, and offshore waters. However, since project emission sources would be mobile, pollutant impacts would not be large enough in a localized area to exceed any ambient air quality standard.

Project emissions would exceed AQMD significance thresholds for all pollutants. The effect of implementing mitigation measures identified in section 4.1.4.1 are presented in tables B-25 and -41. These data show that mitigation measures would decrease project emissions, but only SO₂ emissions would be reduced to insignificance.

G.2.1.2 Hydrology, Groundwater, and Water Quality

The smallest volume of sediment intended for ocean disposal (0.1 mcy) would occur under this alternative. This small volume of sediment (i.e., 0.1 mcy in comparison to 5.4 mcy) would result in no significant impacts to site hydrodynamics and water quality (see section G.1.1.2). Alterations in water quality variables would be localized and would return to background levels quickly.

At the Montezuma Wetlands site, disposal of sediments meeting the state criteria for use as cover material in wetlands creation would be expected to result in no significant impacts on surface and groundwater quality.

G.2.1.3 Geology, Soils, and Seismicity

Material is expected to accrete in thin layers on the bottom of the ocean site and would probably become diluted by mixing with "cleaner" deposited composites and bottom sediments. Attaining background levels in conventional and contaminant constituents would occur faster with this smaller proposed disposal volume for the ocean site than with maximum disposal volume. Only materials found suitable for unconfined, open-water disposal in accordance with the MPRSA would be deposited at the ocean site. The disposal of 0.1 mcy of material at this site would not significantly impact site sediments.

Potentially significant seismic impacts could occur at the Montezuma Wetlands site if a large magnitude earthquake occurred on a nearby fault. In such an event, severe ground motion and liquefaction could occur. Earthquake-induced levee failure at the site could cause geologic hazards on Fire Truck Road or Dinkelspiel Road if a levee were constructed near these roads.

G.2.1.4 Biological Resources

Alternative B1 includes disposal of 0.1 mcy of dredged material at the ocean disposal site. Impacts to the biological community under Alternative B1 would be considerably lower and less extensive than described in section 4.4, which assumed 5.4 mcy of sediment disposed at the site. Sediment deposits are expected to be thinner, resulting in decreased burial and mortality of benthic organisms occurring at the site, and more rapid recolonization of the site by opportunistic species or those which burrow up through the deposit. Turbidity increases during disposal would be less pronounced or less frequent, depending on the amount of material disposed at one time and the frequency of disposal activities. Therefore, any potential effects on the plankton, benthos, fish, mammals, birds and threatened and endangered species would be reduced. In conclusion, impacts of disposal of dredged material at the ocean site according to Alternative B1 would be short-termed and insignificant.

Also under this alternative, approximately 6.4 mcy would be disposed at the Montezuma Wetlands site. This alternative's contribution to the impacts identified for the development of Phase I of the Montezuma Wetlands Project (MWP) (Solano County 1993) would be the same as alternatives C1 and C2. Even if Oakland Harbor sediments are not disposed at the Montezuma site, the same impacts might occur,

however, because the site, if developed, would be available for use by other projects in the Bay Area. These impacts include the loss of 724 acres of jurisdictional wetland that provide seasonal wetland habitat values. As a result of project design, existing wetlands may be converted to alternative types of wetland and aquatic habitats. Leaching or plant uptake of contaminants in dredge spoils may allow these contaminants to enter the food chain and potentially affect sensitive wildlife species, including state- and federally-protected fish and migratory bird species. Losses of habitat and population may occur for several sensitive plant and wildlife species on the site; mitigations for these impacts remain to be defined. Phase I of the MWP would eliminate approximately 15 acres of potential habitat for the salt marsh harvest mouse, a state and federally listed endangered species, but could restore tidal wetlands to most of the site.

G.2.1.5 Cultural Resources

No cultural resources are recorded in the ocean disposal site or in the Port. Several potentially significant cultural resources from both the prehistoric and historic periods are within the Montezuma Wetlands restoration area. Impacts on cultural resources with this alternative would be potentially significant.

G.2.1.6 Noise

Noise associated with use of the ocean disposal site would result primarily from tugboats towing scows to the site. No noise impacts would result from disposing of dredge material at this site, since it is well removed from any sensitive receptors.

Noise from pumps at the unloading station at the Montezuma Wetlands site would cause significant increases in noise levels at nearby residential areas. This impact could be mitigated to insignificance if "critical" grade silencers were installed on the pumps and if they were partially or completely enclosed.

No significant impacts would result from use of the Port/Landfill site due to the lack of sensitive receptors in the vicinity.

G.2.1.7 Transportation

The ocean disposal site is located outside of designated commercial vessel traffic lanes and away from any restricted passage areas, precautionary zones, or anchorages for commercial shipping. Project tugboats would represent additional vessel traffic within the project area. However, in relation to the volume of traffic in the San Francisco Bay area, the increase would be minor, and no significant impacts would occur.

It is anticipated that few, if any, vehicle trips would be generated by selection of the Montezuma Wetlands disposal site, since dredged materials would be placed in scows and towed to the site through Carquinez Strait. Recreational use of the Sacramento River is light, and no significant conflicts between project vessels and recreational vessels are anticipated. Project traffic would be only a small increment of the total vessel traffic associated with operation of this disposal site, and impacts to navigation were not identified as an area of concern in the EIR/EIS prepared for the project.

A portion of the Ninth Avenue Marine Terminal would be used to dry dredged material barged to the site. Dry material would be loaded onto trucks or rail cars for transport to the ultimate disposal site.

The rate of movement would be no more than 96,000 cy in nine months, although the total number of truck trips depends on the volume of material to be moved. A maximum of 32 round trips per working day is estimated. No significant truck or rail impacts would occur.

G.2.1.8 Land Use Plans and Policies

No land use impacts *per se* would result from use of the ocean disposal site. It is located in the waters of the United States and is not subject to local land use plans and policies. The U.S. EPA and the Corps share responsibility for the management of ocean disposal of dredged material. With concurrence from the EPA, the Corps issues permits under MPRSA Section 103 for ocean disposal of dredged material deemed suitable according to EPA criteria in MPRSA Section 102 and EPA regulations in 40 CFR Part 227. Ocean disposal sites must be evaluated using EPA's ocean dumping criteria in 40 CFR Part 228. The ocean disposal site under consideration in this document was evaluated and found to satisfy both the general and specific criteria established by the EPA (1992).

Potential land use impacts, including potentially significant visual effects and conflicts with use of an existing railroad right-of-way, and policy inconsistencies were noted in the EIR/EIS prepared for the Montezuma Wetlands Project (Solano County 1993). However, land use impacts are mitigable, and it is anticipated that policy inconsistencies will be resolved through plan and policy amendments.

Use of the Port site for the proposed temporary rehandling facility would further the Port's shipping mandate, consistent with the Oakland General Plan land use designation of Port-Related Uses and the Port Shoreline Plan land use designation of Shipping. The Ninth Avenue Terminal is located within the jurisdiction of the BCDC and will require a BCDC permit and/or consistency review or certification. The project is consistent with the *San Francisco Bay Area Seaport Plan*.

The ocean disposal site is located in an area where some commercial and recreational fishing occurs. Previous studies (EPA 1992) have indicated that impacts on commercial and recreational fishing uses would be insignificant due to the comparatively limited resources of the area, in addition to the fact that fish would avoid the disposal plumes. Since this disposal site lies outside of designated commercial shipping lanes, the increase in tugboat traffic would have no impact on commercial shipping.

Potentially significant seismic impacts may occur at the Montezuma Wetlands site, if a large magnitude earthquake occurred on a nearby fault. In such an event, severe ground motion and liquefaction could occur. Earthquake-induced levee failure could cause geologic hazards on Fire Truck Road or Dinkelspiel Road, if a levee were constructed near these roads.

G.2.2 Alternative B2 (Ocean, Sonoma Baylands, and Galbraith)

G.2.2.1 Air Quality

Summaries of daily and total emissions that would occur from this alternative are provided in tables B-26 and -42, respectively. Project emissions would occur in Alameda, San Francisco, and Sonoma counties. As shown in Table B-26, daily project emissions of NO_x would exceed one percent of the combined emissions from these counties. Additionally, project emissions would exceed the daily BACT trigger levels for all pollutants. These emissions would therefore be significant.

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Project emissions would be spread over a large portion of the Bay Area region, between the Oakland Harbor, Galbraith Golf Course, Sonoma Baylands, and offshore waters. However, since project emission sources would be mobile, pollutant impacts would not be large enough in a localized area to exceed any ambient air quality standard.

Project emissions would exceed AQMD significance thresholds for all pollutants. The effect of implementing the mitigation measures identified in section 4.1.4.1 are presented in tables B-26 and -42 show retard and reformulated diesel fuel. These data show that the mitigation measures would decrease project emissions, but only SO₂ emissions would be reduced to insignificance.

G.2.2.2 Hydrology, Groundwater, and Water Quality

Under this alternative, approximately 2.9 mcy of dredged material would be placed at the ocean site. This volume is in between maximum disposal volume possibilities (5.4 mcy) and the least disposal volume scenario (0.1 mcy). As such, for the reasons described in section G.1.1.2 and G.2.1.2, no significant impacts to ocean waters are expected.

Upland disposal at the Galbraith Golf Course site could result in significant impacts on surface and groundwater quality, due to the release of salt, metals, tributyltin, and total PAHs, although such impacts are not expected. At the Sonoma Baylands site, no significant impacts are expected on surface and groundwater quality, because only sediments meeting the state criteria for wetlands creation (excluding chromium) would be accepted.

G.2.2.3 Geology, Soils, and Seismicity

No significant impacts on sediments at the ocean site are anticipated for the proposed disposal volume of 2.9 mcy for the reasons described in section G.1.2.3. As noted in section G.1.1.3, the presence of a dredged material deposit with chemical characteristics different from ambient sediments is, in itself, an impact. Compliance with MPRSA guidelines for ocean disposal, however, would preclude significant impacts to site conditions.

Potentially significant seismic impacts could occur at the Galbraith Golf Course site, if a large magnitude earthquake occurred on a nearby fault. In such an event, severe ground motion and liquefaction could occur. Earthquake-induced levee failure could cause geologic hazards on surrounding features such as Doolittle Drive, the interior drainage canal, and the San Leandro Wastewater Treatment Plant.

G.2.2.4 Biological Resources

Approximately 2.9 mcy would be disposed at the ocean disposal site under Alternative B2. As discussed for Alternative B1, impacts to the biological community at the ocean site would be similar to those described in section 4.4 but would be of smaller magnitude and less extensive. Impacts are expected to be minimal and temporary, although somewhat greater than those of Alternative B1. Overall, impacts to the various biological communities (e.g., benthic, fish, and plankton) that would occur at the ocean disposal site are not expected to be significant.

This alternative would require most of the capacity of the Sonoma Baylands and Galbraith Golf Course sites, and impacts would be essentially as described in Chapter 4. At the Sonoma Baylands site, 56.3

acres of seasonal freshwater and brackish wetlands would be filled. The restoration of tidal action would ultimately result in 289 acres of salt marsh wetland and a potential for 24 acres of seasonal wetlands on the site, a beneficial impact that mitigates impacts to existing wetlands. Noise from site construction and disposal operations could adversely affect sensitive bird species (e.g., the California clapper rail, a state and federally listed endangered species) nesting in the salt marsh along San Pablo Bay, if and where these species occur. These impacts, however, can be avoided. At the Galbraith site, approximately 3.7 acres of seasonal freshwater marsh, tidal wetlands, and other waters of the United States (exact acreage to be determined by the Corps) would be filled. Seasonal ponding at the Galbraith site may result in an increase in mosquitos. Consultation with the Alameda County Mosquito Abatement District is recommended to mitigate this impact. Aquatic biota may be disturbed by pipeline construction and pumping operations, and may potentially be impacted by fuel spills or a break in the slurry pipeline. These impacts may be mitigated by setting anchors for the duration of the project; careful handling of fuel; and installation of a leak detection system on the pipe and/or monitoring of the slurry discharge. There is a potential for significant impacts on burrowing owls, if present, a species of special concern. Impacts may be mitigated to insignificance by relocating any owls and active burrows identified during a pre-construction survey. Biological resource impacts at Galbraith are expected to be fully mitigable (see section 4.4.5.6).

G.2.2.5 Cultural Resources

No cultural resources are recorded in the ocean disposal site. Several potentially significant cultural resources from both the prehistoric and historic periods are within the Montezuma Wetlands restoration area. The Galbraith Golf Course is on top of a former landfill, so the likelihood of encountering intact cultural resources within this site is extremely low. Impacts on cultural resources with this alternative would be potentially significant.

G.2.2.6 Noise

Noise associated with use of the ocean disposal site would result primarily from tugboats towing scows to the site. No noise impacts would result from disposing of dredge material at this site, since it is well removed from any sensitive receptors.

At the Sonoma Baylands site, noise from pumps at the unloading station would be insignificant, unless they were operated between the hours of 10 P.M. and 7 A.M. Noise from construction equipment and on-site pumps would be insignificant, since it would be comparable to the relatively high ambient noise levels and due to the distance to the nearest sensitive receptors.

At the Galbraith site, the unloader and booster pumps could cause potentially significant impacts depending on their placement. Impacts could be mitigated to insignificance if the pumps were placed sufficiently far away from sensitive receptors.

G.2.2.7 Transportation

The ocean disposal site is located outside of designated commercial vessel traffic lanes and away from any restricted passage areas, precautionary zones, or anchorages for commercial shipping. Project tugboats would represent additional vessel traffic within the project area. However, in relation to the

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volume of traffic in the San Francisco Bay area, the increase would be minor, and no significant impacts would occur.

There would be no ground transportation under the Sonoma Baylands disposal alternative. Impacts on marine-based transportation are to be determined.

Transport of dredged sediments from Oakland Harbor to the Galbraith Golf Course would be via tug-pushed scows and pipeline from either San Leandro Bay (Option A) or San Francisco Bay (Option B). Because of the shallow waters near the San Leandro shoreline, the tug-drawn scows could only navigate within three miles of the drying pond site. An offloading station would be constructed in the Bay to allow unloading of the sediments via hydraulic pipeline floating on the Bay. Approximately 19,000 round trips would be generated over a four-month period by the transport of levee material to the site. The local roadways can accommodate this short-term increase in traffic, however, and impacts to vessel and ground transportation would be insignificant.

G.2.2.8 Land Use Plans and Policies

No land use impacts *per se* would result from use of the ocean disposal site. It is located in the waters of the United States and is not subject to local land use plans and policies. The U.S. EPA and the Corps share responsibility for the management of ocean disposal of dredged material. With concurrence from the EPA, the Corps issues permits under MPRSA Section 103 for ocean disposal of dredged material deemed suitable according to EPA criteria in MPRSA Section 102 and EPA regulations in 40 CFR Part 227. Ocean disposal sites must be evaluated using EPA's ocean dumping criteria in 40 CFR Part 228. The ocean disposal site under consideration in this document was evaluated and found to satisfy both the general and specific criteria established by the EPA (1992).

Use of the Sonoma Baylands site would result in the loss of about 315 acres currently in agricultural production. This is not considered a significant reduction in agricultural land in proportion to the land available in the County.

The placement of dredged material on the site would be consistent with the State Coastal Conservancy's approved use of the site under the Sonoma Baylands Enhancement Plan, which designates the 348-acre site for tidal marsh restoration. It would also be consistent with the intent of General Plan policies and goals as a whole. Although general land use policies discourage the conversion of agricultural lands to other uses, they also recognize that there may be an overriding public benefit for certain public uses. Impacts on adjacent land uses would be insignificant. Breaching of the perimeter levee would result in a net increase in tidal habitat at the San Pablo Bay National Wildlife Refuge (see section 4.4), which would be consistent with the General Plan policies and goals.

Land use impacts at the Galbraith Golf Course are potentially significant due to the interim 7-year loss of the golf course at the site and displacement of the municipal soccer field at the site. The City of Oakland will construct a new soccer field at the Curt Flood Sports Complex in East Oakland, which will mitigate potential impacts from loss of recreational use of the existing soccer field. Mitigation measures for the 7-year loss of the recreational use of the golf course will include development of a new golf course on site at the end of the 7-year interim construction phase, continuation of the youth golfing program, and subsidizing the cost difference for Oakland resident seniors to play at other golf courses until the new golf course is available.

The ocean disposal site is located in an area where some commercial and recreational fishing occurs. Previous studies (EPA 1992) have indicated that impacts on commercial and recreational fishing uses would be insignificant due to the comparatively limited resources of the area, in addition to the fact that fish would avoid the disposal plumes. Since this disposal site lies outside of designated commercial shipping lanes, the increase in tugboat traffic would have no impact on commercial shipping.

G.2.3 Alternative B3 (Ocean, Sonoma Baylands, and Leonard/Redwood)

G.2.3.1 Air Quality

Summaries of daily and total emissions that would occur from the alternative are provided in tables B-27 and -43, respectively. Project emissions would occur in Alameda, San Francisco, Sonoma, and Marin Counties. As shown in Table B-27, daily project emissions of NO_x would exceed one percent of the combined emissions from these counties. In addition, project emissions would exceed the daily BACT trigger levels for all pollutants. These emissions would therefore be significant.

Project emissions would be spread over a large portion of the Bay Area region, between the Oakland Harbor, Galbraith Golf Course, Sonoma Baylands, and offshore waters. However, since project emission sources would be mobile, pollutant impacts would not be large enough in a localized area to exceed any ambient air quality standard.

Project emissions would exceed AQMD significance thresholds for all pollutants. The effect of implementing the mitigation measures identified in section 4.1.4.1 are presented in tables B-27 and -43. These data show that mitigation measures would decrease project emissions, but only SO₂ emissions would be reduced to insignificance.

G.2.3.2 Hydrology, Groundwater, and Water Quality

The proposed volume of sediment for ocean disposal under this alternative (2.9 mcy) is the same as that under section G.2.2.2. No significant impacts to ocean waters are expected.

Use of Leonard Ranch under this alternative would result in insignificant impacts on surface water and groundwater, due to the release of salt. No significant impacts on surface and groundwater are expected at Redwood Landfill, due to the requirements of the landfill's operating permits. At the Sonoma Baylands site, no significant impacts are expected on surface water and groundwater quality because only sediments meeting the state criteria (excluding chromium) for wetlands creation would be accepted.

G.2.3.3 Geology, Soils, and Seismicity

No significant impacts on sediments at the ocean site are anticipated for the proposed disposal volume of 2.9 mcy for the reason described in section G.2.2.3.

Potentially significant seismic impacts may occur at the Leonard Ranch site, if a large magnitude earthquake occurred on a nearby fault. In such an event, severe ground motion and liquefaction could occur. Earthquake-induced levee failure at the site could cause geologic hazards on Highway 37 and the adjacent railroad tracks.

G.2.3.4 Biological Resources

Like Alternative B2, a maximum of 2.9 mcy of dredged material would be disposed at the ocean site under Alternative B3. Impacts on the biological community would thus be the same as those described for Alternative B2 (i.e., insignificant). This alternative would require most of the capacity of the Sonoma Baylands and Leonard Ranch/Redwood Landfill sites, and impacts would be essentially as described in Chapter 4. At the Sonoma Baylands site, 56.3 acres of seasonal freshwater and brackish wetlands would be filled. The restoration of tidal action would ultimately result in 289 acres of salt marsh wetland and a potential for 24 acres of seasonal wetlands on the site, a beneficial impact that mitigates impacts to existing wetlands. Noise from site construction and disposal operations could adversely affect sensitive bird species (e.g., the California clapper rail, a state and federally listed endangered species) nesting in the salt marsh along San Pablo Bay, if and where these species occur. These impacts, however, can be avoided.

Use of the Leonard Ranch/Redwood Landfill site under this alternative would result in the filling of 31 acres of seasonally inundated marshlands and 2 acres of ditches that presently contain freshwater wetland and aquatic habitats. Sensitive bird species nest in the salt marsh bordering San Pablo Bay and these species, if and where present, could be adversely affected by noise and activity associated with site construction and dredge disposal. Impacts at Leonard Ranch could be mitigated to less than significant levels.

G.2.3.5 Cultural Resources

No cultural resources are recorded in the ocean disposal site. Several potentially significant cultural resources from both the prehistoric and historic periods are within the Montezuma Wetlands restoration area. The Leonard Ranch has not been surveyed and may contain cultural resources. Impacts on cultural resources under this alternative would be potentially significant.

G.2.3.6 Noise

At the Sonoma Baylands site, noise from pumps at the unloading station would be insignificant, unless they were operated between the hours of 10 P.M. and 7 A.M. Noise from construction equipment and on-site pumps would be insignificant, since it would be comparable to the relatively high ambient noise levels and due to the distance to the nearest sensitive receptors.

No significant noise impacts would result from use of the Leonard Ranch or Redwood Landfill sites.

G.2.3.7 Transportation

The ocean disposal site is located outside of designated commercial vessel traffic lanes and away from any restricted passage areas, precautionary zones, or anchorages for commercial shipping. Project tugboats would represent additional vessel traffic within the project area. However, in relation to the volume of traffic in the San Francisco Bay area, the increase would be minor, and no significant impacts would occur.

There would be no ground transportation under the Sonoma Baylands disposal alternative. Impacts on marine-based transportation are to be determined.

Dredged material would be transported to the Leonard Ranch site by scows towed by tugs. The tugs would use navigable channels through San Pablo Bay to deliver sediments to a point in the mouth of the Petaluma approximately 3,000 feet south of the Port Sonoma-Marin. The increase in vessel trips would be consistent with established movements. The offloading facility that would be constructed is located in a naturally wide and deep area and should not adversely affect local navigation.

Up to 1.2 mcy of dredged material could be dried at the Leonard Ranch site. The dried material would be transported to the Redwood Landfill. After the first year, material would be hauled by trucks. The project could increase the risk of accidents significantly on Landfill Road; additionally, increased traffic in the vicinity of the landfill would cause a significant impact. Mitigation measures such as avoiding peak hours and following an alternative route would reduce impacts to insignificance.

G.2.3.8 Land Use Plans and Policies

No land use impacts *per se* would result from use of the ocean disposal site. It is located in the waters of the United States and is not subject to local land use plans and policies. The U.S. EPA and the Corps share responsibility for the management of ocean disposal of dredged material. With concurrence from the EPA, the Corps issues permits under MPRSA Section 103 for ocean disposal of dredged material deemed suitable according to EPA criteria in MPRSA Section 102 and EPA regulations in 40 CFR Part 227. Ocean disposal sites must be evaluated using EPA's ocean dumping criteria in 40 CFR Part 228. The ocean disposal site under consideration in this document was evaluated and found to satisfy both the general and specific criteria established by the EPA (1992).

Use of the Sonoma Baylands site would result in the loss of about 315 acres currently in agricultural production. This is not considered a significant reduction in agricultural land in proportion to the land available in the County.

The placement of dredged material on the Sonoma Baylands site would be consistent with the State Coastal Conservancy's approved use of the site under the Sonoma Baylands Enhancement Plan, which designates the 348-acre site for tidal marsh restoration. It would also be consistent with the intent of General Plan policies and goals as a whole. Although general land use policies discourage the conversion of agricultural lands to other uses, they also recognize that there may be an overriding public benefit for certain public uses. Impacts on adjacent land uses would be insignificant.

The proposed rehandling facility at the Leonard Ranch site would result in the loss of about 215 acres currently in agricultural production on Leonard Ranch and the loss of an undetermined amount in the northernmost parcel. A financial analysis is in progress; no significant land use impacts from loss of agricultural land have been identified to date.

Much of the Leonard Ranch site is currently in agricultural production. The Sonoma County General Plan discourages the conversion of such lands to non-agricultural use, but provides that public uses may be approved if an overriding public benefit exists. The proposed rehandling facility would be inconsistent with the General Plan's policy unless it can be demonstrated that the facility would constitute an overriding public benefit. The project may also be inconsistent with General Plan scenic resources policies. Use of the site would not significantly impact nearby land uses. No land use policy conflicts are expected from use of the Redwood Landfill site.

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The ocean disposal site is located in an area where some commercial and recreational fishing occurs. Previous studies (EPA 1992) have indicated that impacts on commercial and recreational fishing would be insignificant due to the comparatively limited resources of the area, in addition to the fact that fish would avoid the disposal plumes. Since this disposal site lies outside of designated commercial shipping lanes, the increase in tugboat traffic would have no impact on commercial shipping.

G.3 ALL UPLAND DISPOSAL

G.3.1 Alternative C1 (Montezuma Wetlands and Galbraith)

G.3.1.1 Air Quality

Summaries of daily and total emissions that would occur from the alternative are provided in tables B-28 and -44, respectively. Project emissions would occur in Alameda, Contra Costa, and Solano Counties. As shown in Table B-28, daily project emissions of NO_x would not exceed one percent of the combined emissions from these counties. Project emissions would also exceed the daily BACT trigger levels for all pollutants. These emissions would therefore be significant.

Project emissions would be spread over a large portion of the Bay Area region, between the Oakland Harbor, Galbraith Golf Course, and Montezuma Wetlands. However, since project emission sources would be mobile, pollutant impacts would not be large enough to exceed any ambient air quality standard in a localized area.

Project emissions would exceed AQMD significance thresholds for all pollutants. The effect of implementing the mitigation measures identified in section 4.1.4.1 are presented in tables B-28 and -44. These data show that the NO_x mitigation measure would be effective in reducing daily NO_x emissions to less than one percent of the combined counties' NO_x emissions. However, project emissions would remain above all of the daily BACT significance levels (except SO₂).

G.3.1.2 Hydrology, Groundwater, and Water Quality

Upland disposal at the Galbraith Golf Course site could result in significant impacts on surface and groundwater quality, due to the release of salt, metals, tributyltin, and total PAHs, although such impacts are not expected. At the Montezuma Wetlands site, disposal of sediments meeting the state criteria for use as cover and non-cover material in wetlands creation would be expected to result in no significant impacts on surface and groundwater quality.

G.3.1.3 Geology, Soils, and Seismicity

Potentially significant seismic impacts may occur at the Galbraith Golf Course or Montezuma Wetlands site, if a large magnitude earthquake occurred on a nearby fault. In such an event, severe ground motion and liquefaction could occur at either site. At the Galbraith Golf Course site, earthquake-induced levee failure could cause geologic hazards on surrounding features such as Doolittle Drive, the interior drainage canal, and the San Leandro Wastewater Treatment Plant. At the Montezuma Wetlands site, earthquake-induced levee failure could cause geologic hazards on Fire Truck Road or Dinkelspiel Road if a levee were constructed near these roads.

G.3.1.4 Biological Resources

Under this alternative, approximately 6.4 mcy would be disposed at the Montezuma Wetlands site. Even if Oakland Harbor sediments are not disposed at the Montezuma site, the same impacts might occur, however, because the site, if developed, would be available for use by other projects in the Bay Area. These impacts include the loss of 724 acres of jurisdictional wetlands that provide seasonal wetland habitat values. As a result of project design, existing wetlands may be converted to alternative types of wetland and aquatic habitats. Leaching or plant uptake of contaminants in dredge spoils may allow these contaminants to enter the food chain and potentially affect sensitive wildlife species, including state- and federally-protected fish and migratory bird species. Losses of habitat and population may occur for a number of sensitive plant and wildlife species on the site; these impacts remain to be defined. Phase I of the Montezuma Wetlands Project would eliminate approximately 15 acres of potential habitat for the salt marsh harvest mouse, a federally listed endangered species, but would restore tidal wetlands to most of the site.

At the Galbraith site, approximately 3.7 acres of seasonal freshwater marsh, tidal wetlands, and other waters of the United States (exact acreage to be determined by the Corps) would be filled. Seasonal ponding at the Galbraith site may result in an increase in mosquitos. Consultation with the Alameda County Mosquito Abatement District is recommended to mitigate this impact. Aquatic biota may be disturbed by pipeline construction and pumping operations, and may potentially be impacted by fuel spills or a break in the slurry pipeline. These impacts may be mitigated by setting anchors for the duration of the project; careful handling of fuel; and installation of a leak detection system on the pipe and/or monitoring of the slurry discharge. There is a potential for significant impacts on burrowing owls, if present, a species of special concern. Impacts may be mitigated to insignificance by relocating any owls and active burrows identified during a pre-construction survey. Significant impacts are mitigable at this site (see section 4.4.5.6).

G.3.1.5 Cultural Resources

The Galbraith Golf Course is on top of a former landfill so the likelihood of intact cultural resources within this area is extremely low. No impacts on cultural resources are anticipated with this alternative.

G.3.1.6 Noise

Noise from pumps at the unloading station at the Montezuma Wetlands site would cause significant increases in noise levels at nearby residential areas. This impact could be mitigated to insignificance if "critical" grade silencers were installed on the pumps and if they were partially or completely enclosed.

At the Galbraith site, the unloader and booster pumps could cause potentially significant impacts depending on their placement. Impacts could be mitigated to insignificance if the pumps were placed sufficiently far away from sensitive receptors.

G.3.1.7 Transportation

It is anticipated that few, if any, vehicle trips would be generated by selection of the Montezuma Wetlands disposal site, since dredged materials would be placed in scows and towed to the site through Carquinez Strait. Recreational use of the Sacramento River is light, and no significant conflicts between

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project vessels and recreational vessels are anticipated. Project traffic would be only a small increment of the total vessel traffic associated with operation of this disposal site, and impacts to navigation were not identified as an area of concern in the EIR/EIS prepared for the project.

Transport of dredged sediments from Oakland Harbor to the Galbraith Golf Course would be via tug-pushed scows and pipeline from either San Leandro Bay (Option A) or San Francisco Bay (Option B). Because of the shallow waters near the San Leandro shoreline, the tug-drawn scows could only navigate within three miles of the drying pond site. An offloading station would be constructed in the Bay to allow unloading of the sediments via hydraulic pipeline floating on the Bay. Approximately 19,000 roundtrips would be generated over a four-month period by the transport of levee material to the site. The local roadways can accommodate this short-term increase in traffic, however, and impacts to vessel and ground transportation would be insignificant.

G.3.1.8 Land Use Plans and Policies

Potential land use impacts, including potentially significant visual effects and conflicts with use of an existing railroad right-of-way, and policy inconsistencies will be addressed in the EIR/EIS being prepared for the Montezuma Wetlands Project by Solano County. However, land use impacts are mitigable, and it is anticipated that policy inconsistencies will be resolved through plan and policy amendments. Potential land use impacts would result from conversion of the site to a disposal site, an action that is separate from the proposed Oakland Harbor deepening project, rather than from use of the site if it is approved.

Land use impacts at the Galbraith Golf Course are potentially significant due to the interim 7-year loss of the golf course at the site and displacement of the municipal soccer field at the site. The City of Oakland will construct a new soccer field at the Curt Flood Sports Complex in East Oakland, which will mitigate potential impacts from loss of recreational use of the existing soccer field. Mitigation measures for the 7-year loss of the recreational use of the golf course will include development of a new golf course on site at the end of the 7-year interim construction phase, continuation of youth golfing program, and subsidizing the cost difference for Oakland resident seniors to play at other golf courses until the new golf course is available.

G.3.2 Alternative C2 (Montezuma Wetlands and Leonard/Redwood)

G.3.2.1 Air Quality

Summaries of daily and total emissions that would occur from this alternative are provided in tables B-29 and -45, respectively. Project emissions would occur in Alameda, Contra Costa, Solano, Sonoma, and Marin counties. As shown in Table B-31, project emissions would exceed the daily BACT trigger levels for all pollutants. These emissions would therefore be significant.

Project emissions would be spread over a large portion of the Bay Area region, between the Oakland Harbor, Leonard Ranch, Redwood Landfill, and Montezuma Wetlands. However, since project emission sources would be mobile, pollutant impacts would not be large enough in a localized area to exceed any ambient air quality standard.

Project emissions would exceed AQMD significance thresholds for all pollutants. The effect of implementing the mitigation measures identified in section 4.1.4.1 are presented in tables B-29 and -45. These data show that mitigation measures would decrease project emissions, but only SO₂ emissions would be reduced to insignificance.

G.3.2.2 Hydrology, Groundwater, and Water Quality

Use of Leonard Ranch under this alternative would result in insignificant impacts on surface and groundwater, due to the release of salt. No significant impacts on surface and groundwater are expected at Redwood Landfill, due to the requirements of the landfill's operating permits. At the Montezuma Wetlands site, disposal of sediments meeting the state criteria for use as cover and non-cover material in wetlands creation would be expected to result in no significant impacts on surface and groundwater quality.

G.3.2.3 Geology, Soils, and Seismicity

Potentially significant seismic impacts may occur at the Leonard Ranch or Montezuma Wetlands site, if a large magnitude earthquake occurred on a nearby fault. In such an event, severe ground motion and liquefaction could occur at either site. At the Leonard Ranch site, earthquake-induced levee failure at the site could cause geologic hazards on Highway 37 and the adjacent railroad tracks. At the Montezuma Wetlands site, earthquake-induced levee failure could cause geologic hazards on Fire Truck Road or Dinkelspiel Road if a levee were constructed near these roads.

G.3.2.4 Biological Resources

Under this alternative, approximately 6.4 mcy would be disposed at the Montezuma Wetlands site. This alternative's contribution to the impacts identified for the development of Phase I of the Montezuma Wetlands Project (MWP) (Solano County 1993) would be the same as alternatives B1, C1, and C2. Even if Oakland Harbor sediments are not disposed at the Montezuma site, the same impacts might occur, however, because the site, if developed, would be available for use by other projects in the Bay Area. These impacts include the loss of 724 acres of jurisdictional wetland that provide seasonal wetland habitat values. As a result of project design, existing wetlands may be converted to alternative types of wetland and aquatic habitats. Leaching or plant uptake of contaminants in dredge spoils may allow these contaminants to enter the food chain and potentially affect sensitive wildlife species, including state- and federally-protected fish and migratory bird species. Losses of habitat and population may occur for several sensitive plant and wildlife species on the site; mitigations for these impacts remain to be defined. Phase I of the MWP would eliminate approximately 15 acres of potential habitat for the salt marsh harvest mouse, a state and federally listed endangered species, but could restore tidal wetlands to most of the site.

Use of the Leonard Ranch/Redwood Landfill site under this alternative would entail disposal of 200,000 cy, and impacts would be reduced relative to the analysis in Chapter 4. Some loss of wetland habitat, comprising seasonally inundated marshlands and ditches, would still be likely and require mitigation. Noise and disturbance impacts on sensitive bird species that nest in the salt marsh bordering San Pablo Bay would be potentially significant. These impacts would, however, be more readily avoided under this alternative than under other alternatives that, because of larger disposed volumes, would require use of most or all of this site's capacity.

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G.3.2.5 Cultural Resources

No cultural sites are recorded within the Leonard Ranch or Redwood Landfill. Because Leonard Ranch has not been surveyed, there is a potential for encountering cultural resources. Impacts on cultural resources thus are considered potentially significant with this alternative.

G.3.2.6 Noise

Noise from pumps at the unloading station at the Montezuma Wetlands site would cause significant increases in noise levels at nearby residential areas. This impact could be mitigated to insignificance if "critical" grade silencers were installed on the pumps and if they were partially or completely enclosed.

No significant noise impacts would result from use of the Leonard Ranch or Redwood Landfill sites.

G.3.2.7 Transportation

It is anticipated that few, if any, vehicle trips would be generated by selection of the Montezuma Wetlands disposal site, since dredged materials would be placed in scows and towed to the site through Carquinez Strait. Recreational use of the Sacramento River is light, and no significant conflicts between project vessels and recreational vessels are anticipated. Project traffic would be only a small increment of the total vessel traffic associated with operation of this disposal site, and impacts to navigation were not identified as an area of concern in the EIR/EIS prepared for the project.

G.3.2.8 Land Use Plans and Policies

Potential land use impacts including potentially significant visual effects and conflicts with use of an existing railroad right-of-way, and policy inconsistencies will be addressed in the EIR/EIS being prepared for the Montezuma Wetlands Project by Solano County. However, land use impacts are mitigable, and it is anticipated that policy inconsistencies will be resolved through plan and policy amendments. Potential land use impacts would result from conversion of the site to a disposal site, an action that is separate from the proposed Oakland Harbor deepening project, rather than from use of the site if it is approved.

Much of the Leonard Ranch site is currently in agricultural production. The proposed rehandling facility at the Leonard Ranch site would result in the loss of about 215 acres currently in agricultural production on Leonard Ranch and the loss of an undetermined amount in the northernmost parcel. A financial analysis is in progress; no significant land use impacts from loss of agricultural land have been identified to date. The Sonoma County General Plan discourages the conversion of such lands to non-agricultural use, but provides that public uses may be approved if an overriding public benefit exists. The proposed Leonard Ranch rehandling facility would be inconsistent with the General Plan's policy unless it can be demonstrated that the facility would constitute an overriding public benefit. The project may also be inconsistent with General Plan scenic resources policies. Use of the site would not significantly impact nearby land uses. No land use policy conflicts are expected from use of the Redwood Landfill site.

G.4 ALTERNATIVE D1 (MAXIMUM CONFINED AQUATIC DISPOSAL)

G.4.1 Air Quality

Summaries of daily and total emissions that would occur from the alternative are provided in tables B-30 and -46, respectively. Project emissions would occur only in Alameda County. As shown in Table B-30, daily project emissions of NO_x would exceed one percent of the emissions from the county. Project emissions would also exceed the daily BACT trigger levels for all pollutants. These emissions would therefore be significant.

Project emissions would be spread over a large area between the Oakland Harbor and BFBA. However, since project emission sources would be mobile, pollutant impacts would not be large enough in a localized area to exceed any ambient air quality standard.

Project emissions would exceed AQMD significance thresholds for all pollutants. The effect of implementing the mitigation measures identified in section 4.1.4.1 are presented in tables B-30 and -46. These data show that mitigation measures would decrease project emissions, but only SO₂ emissions would be reduced to insignificance.

G.4.2 Hydrology, Groundwater, and Water Quality

The maximum volume of dredged material found unsuitable for unconfined, open-water disposal is 1.8 mcy. This sediment would be placed at the BFBA where it would be completely covered by 4.8 mcy of "clean" material deemed suitable for unconfined, open-water disposal under the Clean Water Act and PN 93-2. This disposal scenario and its potential water column impacts have been discussed in detail in section 4.2. Using dispersion modeling, it was predicted that at no time would the concentration of dredged material exceed 0.49 percent in the water column. Both the suitable and unsuitable materials were found to be in compliance with the Limiting Permissible Concentration of 0.49 percent and, therefore, water quality objectives of the RWQCB in terms of toxicity would be achieved. However, dissolved oxygen concentrations may be depleted during disposal operations to levels below the minimum 5.0 mg/L standard set by the RWQCB. This effect would be localized and short term. Moreover, the placement of cap material using controlled submerged pipeline may reduce oxygen depletion effects. Impacts on other water quality variables would also be localized and ephemeral. As such, significant impacts to the water column are not expected.

G.4.3 Geology, Soils, and Seismicity

In this confined aquatic disposal scenario, sediments found unsuitable for in-Bay disposal would be placed in the BFBA and capped with "suitable" sediments. Ambient BFBA sediments would, unavoidably, be degraded by the addition of contaminated sediments. Impacts to sediment quality would be limited to the period of time they remain uncapped. Sediment impacts *per se* are not expected to be significant because capping is expected to effectively isolate contaminant release. The cap material will improve the quality of sediments placed there (i.e., unsuitable materials) and, for some parameters, will actually improve the quality of pre-disposal BFBA sediments. The assessment of significant impacts to sediment quality under this scenario depends on both the amount of time between contaminated sediment placement and cap placement and the cap design itself. Capping activities would take place after all unsuitable material had been placed. The cap has a life expectancy of 50 years, at which time additional management actions

would be taken. Assuming cap placement is successful in confining the contaminated sediments (thereby minimizing contaminant release), no significant long-term impacts to sediment quality are expected. Implications with respect to the timing of cap placement are discussed in the biological resources section, G.4.4.

G.4.4 Biological Resources

According to this alternative, approximately 1.8 mcy of unsuitable dredged material for aquatic disposal (as determined by sediment chemistry, toxicity testing, and bioaccumulation tests) would be disposed at the BFBA and capped with a maximum of 4.8 mcy of suitable material dredged from Oakland Harbor. The potential impacts of this alternative are assessed more fully in section 4.4. Physical effects on the biota as a result of increased turbidity (e.g., clogged gills and feeding appendages, reduced dissolved oxygen in the water column, and decreased primary production) are expected to be insignificant. Increased turbidity could affect eggs or activities of fish such as herring, which may spawn in eelgrass beds southeast of the borrow area. However, according to dispersion models representing the worst-case scenario for dispersion of dredged material, only a small concentration is expected to reach the eelgrass beds so impacts are expected to be insignificant.

The benthic infauna present in the disposal target zone (the borrow pit) would not be expected to survive, although more motile species such as fish and crabs could escape from the site during disposal operations. If dredged material is placed periodically at the site, the benthic community that recolonizes the site would be expected to consist primarily of opportunistic species. Once cap placement is complete, the community that develops would likely consist of species which currently exist at the site and those found in sandier regions adjacent to the pit. Because most of the fish, crab, and shrimp species found within the borrow pit were also present in regions surrounding the pit, loss of the current borrow pit habitat is not expected to be significant to the fish community in the vicinity of the disposal site. Similarly, impacts on birds and mammals (including threatened and endangered species), such as a temporary reduction in prey at the release site, are expected to be insignificant.

Since unsuitable material is expected to be capped initially following disposal, toxic effects (acute to sublethal) and bioaccumulation/biomagnification of chemical contaminants in the sediment are not expected to occur in various organisms found at the site. Based on the results of SPP tests, suspended-phase particulate toxic effects associated with increased turbidity conditions are not expected to occur for any organisms present at the site, provided the material is disposed when current velocities are less than 1.15 feet per second. Results of acute toxicity and bioaccumulation tests on benthic infauna and fish indicated that mortality, abnormal development, and bioaccumulation of chemical contaminants may occur in the tissues of clams, worms, amphipods, and juvenile sanddabs when exposed to the unsuitable material. According to the current design of disposing unsuitable material in individual cells and immediately capping the cell of unsuitable material, so that recolonization of the unsuitable material by benthic infauna would be prevented due to continual disturbance while unsuitable material is disposed. The community (benthic infauna and predators) that may develop on the initial cell cap prior to final overall capping of the area is not expected to significantly bioaccumulate contaminants.

Therefore biomagnification of contaminants in birds, mammals, and threatened, and endangered species feeding on fish found at the BFBA is expected to be insignificant. Because the birds and mammals are capable of avoiding the dredge plume and forage in areas other than the disposal site, levels of contaminants (if any) that accumulate in tissues are expected to be minimal. Once the cap of suitable

material is in place, biomagnification of contaminants in birds and marine mammals (including threatened and endangered species) is expected to be insignificant.

G.4.5 Cultural Resources

No cultural resources are recorded in the BFBA. No impacts on cultural resources are therefore anticipated with this alternative.

G.4.6 Noise

Noise associated with use of the BFBA would result primarily from tugboats towing scows to the disposal site. No noise impacts would result from disposing of dredge material at this site, since no sensitive receptors are present in the vicinity of the project.

G.4.7 Transportation

The BFBA is not located within any major shipping channels, and impacts would be insignificant (PTI 1989).

G.4.8 Land Use Plans and Policies

No impacts to land uses would result from use of the BFBA. Use of this site would be potentially inconsistent, however, with *San Francisco Bay Plan* dredging policies, which require that dredged material be disposed of in ocean disposal or non-tidal sites unless such sites prove infeasible. It would also be potentially inconsistent with water quality policies of the *Bay Plan* due to short-term depletion of dissolved oxygen and the release of contaminants to the environment. The project could be brought into consistency through implementation of mitigation measures identified in this document, however.

At the BFBA, impacts to commercial and recreational fishing would be short-term, localized, and insignificant. Most fish would be able to avoid the plume, and while some mortality may occur as a result of burial during disposal, it is expected to be minimal. No significant impacts to commercial shipping would result from use of this disposal site.

G.5 MAXIMUM IN-BAY UNCONFINED AQUATIC DISPOSAL

G.5.1 Alternative E1 (Ocean, Alcatraz, and Galbraith)

G.5.1.1 Air Quality

Summaries of daily and total emissions that would occur from this alternative are provided in tables B-31 and -47, respectively. Project emissions would occur in Alameda and San Francisco Counties. As shown in Table B-31, daily project emissions of NO_x would exceed one percent of the combined emissions from these counties. Project emissions would also exceed the daily BACT trigger levels for all pollutants. These emissions would therefore be significant.

Project emissions would be spread over a large portion of the Bay Area region, between the Oakland Harbor, Galbraith Golf Course, Alcatraz Island, and offshore waters. However, since project emission

sources would be mobile, pollutant impacts would not be large enough in a localized area to exceed any ambient air quality standard.

Project emissions would exceed AQMD significance thresholds for all pollutants. The effect of implementing the mitigation measures identified in section 4.1.4.1 are presented in tables B-31 and -47. These data show that mitigation measures would decrease project emissions, but only SO₂ emissions would be reduced to insignificance.

G.5.1.2 Hydrology, Groundwater, and Water Quality

This alternative includes the disposal of 4.8 mcy of "suitable" dredged material at the Alcatraz disposal site and 0.7 mcy of suitable material at the ocean site. The volume of sediment proposed for disposal at the ocean site is less than the disposal volumes under Alternatives B2 and B3. No significant impacts are expected under these two alternatives, consequently, no significant impacts to ocean site waters are anticipated under this scenario (see section G.2.2.2). Potential impacts associated with material disposal at Alcatraz have been discussed in section 4.2, where the discussions assume maximum volume disposal at the Alcatraz disposal site. Disposal at Alcatraz would be carefully managed by the Corps to comply with target 30-day disposal volumes. These controls would extend the dredging period if maximum use of Alcatraz is exercised. Alterations to water quality parameters (with the exception of suspended solids) are expected to be short-term (less than 3 minutes during each disposal event) and near field. Total suspended solids have been measured in the field in the past at Alcatraz, where concentrations of 165 mg/L or less have been recorded, and disposal plumes typically dissipate within 30 minutes of release. Only materials in compliance with Limiting Permissible Concentration requirements would be discharged at the Alcatraz disposal site. Criteria set by the RWQCB for conventional parameters and toxicity are expected to be achieved (see section 4.2).

Contributions of suspended solids caused by disposal operations at Alcatraz could reach 1.83 mcy using the predictions of Teeter (1987). Up to half of this volume could leave the Bay through the Golden Gate. In comparison to Bay-wide contributors to sediment load, the Alcatraz alternative is very small. The largest contributor to sediment load in the Bay annually is resuspended sediment (160 mcy) and the Delta region provides another 8.0 to 10.5 mcy on an annual basis (PTI 1989). Based on this evidence, water column impacts at the Alcatraz disposal site are expected to be insignificant. This assessment does not include impacts associated with high frequencies of disposal events since these data are not available.

Upland disposal at the Galbraith Golf Course site could result in significant impacts on surface and groundwater quality, due to the release of salt, metals, tributyltin, and total PAHs, although such impacts are not expected.

G.5.1.3 Geology, Soils, and Seismicity

This alternative involves use of both the ocean site and Alcatraz disposal site. The volume of material proposed for disposal at the ocean site (0.7 mcy) is comparable to the volume proposed for disposal under Alternatives E2, E3, and E4 and less than Alternatives B2 and B3. No significant impacts to sediment quality are expected for this volume of material. Potential consequences to sediment quality as a result of disposal activities at Alcatraz are discussed in section 4.3 and represent a worst-case-scenario in terms of maximum disposal volumes. Materials proposed for disposal at Alcatraz have passed testing requirements under the Clean Water Act and PN 93-2, precluding significant impacts to sediment quality.

Moreover, historical use of Alcatraz has resulted in an extremely heterogeneous substrate. The site displays substantial disturbance by virtue of the high rate of disposal activity occurring there. Disposal of materials deemed suitable for unconfined, open-water disposal may improve sediment quality at Alcatraz overall. Implementation of the Corps's 30-day volume targets is essential to avoid excessive accumulations of sediment that could, if not managed carefully, result in a navigation hazard. No significant impacts to sediment quality are expected at the Alcatraz disposal site for this project.

Potentially significant seismic impacts may occur at the Galbraith Golf Course site, if a large magnitude earthquake occurred on a nearby fault. In such an event, severe ground motion and liquefaction could occur. Earthquake-induced levee failure at the site could cause geologic hazards on surrounding features such as Doolittle Drive, the interior drainage canal, and the San Leandro Wastewater Treatment Plant.

G.5.1.4 Biological Resources

Alternative E1 calls for approximately 0.7 mcy of dredged material to be disposed at the ocean site and 4.8 mcy at the Alcatraz disposal site. Impacts to the biological community at the disposal site would not be significant and would be similar to those described for Alternatives B2, B3, and E2 through E4. Impacts that would occur for maximum disposal (4.8 mcy of dredged material) at the Alcatraz site are addressed in section 4.4. For Alternative E1, impacts at Alcatraz would be the same as those described for maximum disposal. Physical impacts as a result of increased turbidity are expected to be minimal and localized for all the organisms present and should last only until the dredge plume dissipates. Because dredged material has been disposed periodically at the Alcatraz site, the benthic community at the site is characterized by species adapted to disturbance and is expected to recover rapidly subsequent to disposal. Fish, birds, crabs, and marine mammals are highly mobile, and should be able to avoid the dredge plume, so that impacts on these species are not expected to be significant. In order to minimize impacts on species migrating through the site (e.g., Dungeness crabs, winter-run chinook salmon, and striped bass), disposal during periods when the species are not migrating (e.g., summer) would minimize potential impacts on these species. Additionally, disposal during ebb tide would help flush suspended particulates out of the Bay and not further into the Bay, so that effects on water column biota would be further reduced.

Only sediments determined as suitable for in-Bay disposal would be released at the site. Therefore, no significant toxic effects on the various biota are expected to occur. Bioaccumulation of some chemicals (e.g., PAHs and metals) may occur in some of the benthic infauna, although levels would be minor. These chemicals are not expected to biomagnify in higher trophic levels such as fish, birds, or mammals.

At the Galbraith site, approximately 3.7 acres of seasonal freshwater marsh, tidal wetlands, and other waters of the United States (exact acreage to be determined by the Corps) would be filled. Seasonal ponding at the Galbraith site may result in an increase in mosquitos. Consultation with the Alameda County Mosquito Abatement District is recommended to mitigate this impact. Aquatic biota may be disturbed by pipeline construction and pumping operations, and may potentially be impacted by fuel spills or a break in the slurry pipeline. These impacts may be mitigated by setting anchors for the duration of the project; careful handling of fuel; and installation of a leak detection system on the pipe and/or monitoring of the slurry discharge. There is a potential for significant impacts on burrowing owls, if present, a species of special concern. Impacts may be mitigated to insignificance by relocating any owls and active burrows identified during a pre-construction survey. Significant impacts at this site are mitigable (see section 4.4.5.6).

G.5.1.5 Cultural Resources

No cultural resources are recorded in the ocean disposal site, the Alcatraz site, or Galbraith. No impacts on cultural resources are therefore anticipated with this alternative.

G.5.1.6 Noise

Noise associated with use of the ocean disposal site would result primarily from tugboats towing scows to the site. No noise impacts would result from disposing of dredge material at this site, since it is well removed from any sensitive receptors.

Noise at the Alcatraz site would result primarily from tugboats towing scows to the disposal site. It is located in the incoming traffic lane for San Francisco Bay. Due to the existing ship noise in the area and the distance to the nearest sensitive receptors, there would not be any noticeable change in noise at the sensitive receptors.

At the Galbraith site, the unloader and booster pumps could cause potentially significant impacts depending on their placement. Impacts could be mitigated to insignificance if the pumps were placed sufficiently far away from sensitive receptors.

G.5.1.7 Transportation

The ocean disposal site is located outside of designated commercial vessel traffic lanes and away from any restricted passage areas, precautionary zones, or anchorages for commercial shipping. Project tugboats would represent additional vessel traffic within the project area. However, in relation to the volume of traffic in the San Francisco Bay area, the increase would be minor, and no significant impacts would occur.

Scows would be towed by tugboat would be towed to the Alcatraz site, positioned, and dumped. The tug/scow combinations would travel a total distance of approximately 6 nautical miles each way. The dredge scow path for this site involves crossing traffic lanes just east of Alcatraz on the outbound leg and south of the Bay Bridge on the inbound leg. These are relatively high risk maneuvers, but well established ones for the masters of the tugboats and scows. Additionally, this site has been used for many years, so that dredge disposal activities are known and expected. After previous dredged sediment disposal at this site, some shoaling has occurred, but this has not caused any significant impacts to navigation.

Transport of dredged sediments from Oakland Harbor to the Galbraith Golf Course would be via tug-pushed scows and pipeline from either San Leandro Bay (Option A) or San Francisco Bay (Option B). Because of the shallow waters near the San Leandro shoreline, the tug-drawn scows could only navigate within three miles of the drying pond site. An offloading station would be constructed in the Bay to allow unloading of the sediments via hydraulic pipeline floating on the Bay. Approximately 19,000 round trips would be generated over a four-month period by the transport of levee material to the site. The local roadways can accommodate this short-term increase in traffic, however, and impacts to vessel and ground transportation would be insignificant.

G.5.1.8 Land Use Plans and Policies

No land use impacts *per se* would result from use of the ocean disposal site. It is located in the waters of the United States and is not subject to local land use plans and policies. The U.S. EPA and the Corps share responsibility for the management of ocean disposal of dredged material. With concurrence from the EPA, the Corps issues permits under MPRSA Section 103 for ocean disposal of dredged material deemed suitable according to EPA criteria in MPRSA Section 102 and EPA regulations in 40 CFR Part 227. Ocean disposal sites must be evaluated using EPA's ocean dumping criteria in 40 CFR Part 228. The ocean disposal site under consideration in this document was evaluated and found to satisfy both the general and specific criteria established by the EPA (1992).

The ocean disposal site is located in an area where some commercial and recreational fishing occurs. Previous studies (EPA 1992) have indicated that impacts would be insignificant due to the comparatively limited resources of the area, in addition to the fact that fish would avoid the disposal plumes. Since this disposal site lies outside of designated commercial shipping lanes, the increase in tugboat traffic would have no impact on commercial shipping.

No impacts to land uses would result from disposal at the Alcatraz site. Use of this site for disposal of dredged materials is anticipated to have no significant impacts on commercial or sport fishing uses. Impacts to the fish community at Alcatraz are expected to be short-term and minimal. Fish should be able to avoid the site or tolerate disposal activities. No significant impacts to commercial shipping would result from use of this disposal site. Use of this site would be potentially inconsistent, however, with *San Francisco Bay Plan* dredging policies which require that dredged material be disposed of in ocean disposal or non-tidal sites unless such sites prove infeasible.

Land use impacts at the Galbraith Golf Course are potentially significant due to the interim 7-year loss of the golf course at the site and displacement of the municipal soccer field at the site. The City of Oakland will construct a new soccer field at the Curt Flood Sports Complex in East Oakland, which will mitigate potential impacts from loss of recreational use of the existing soccer field. Mitigation measures for the 7-year loss of the recreational use of the golf course will include development of a new golf course on site at the end of the 7-year interim construction phase, continuation of the youth golfing program, and subsidizing the cost difference for Oakland resident seniors to play at other golf courses until the new golf course is available.

G.5.2 **Alternative E2 (Ocean, Borrow Area, and Galbraith)**

G.5.2.1 Air Quality

Summaries of daily and total emissions that would occur from the alternative are provided in tables B-32 and -48, respectively. Project emissions would occur in Alameda and San Francisco counties. As shown in Table B-32, daily project emissions of NO_x and SO₂ would exceed one percent of the combined emissions from these counties. Project emissions would also exceed the daily BACT trigger levels for all pollutants. These emissions would therefore be significant.

Project emissions would be spread over a large portion of the Bay Area region, between the Oakland Harbor, Galbraith Golf Course, BFBA, and offshore waters. However, since project emission sources

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would be mobile, pollutant impacts would not be large enough in a localized area to exceed any ambient air quality standard.

Project emissions would exceed AQMD significance thresholds for all pollutants. The effect of implementing the mitigation measures identified in section 4.1.4.1 are presented in tables B-32 and -48. These data show that mitigation measures would decrease project emissions, but only SO₂ emissions would be reduced to insignificance.

G.5.2.2 Hydrology, Groundwater, and Water Quality

In this disposal scenario, the 4.8 mcy proposed for disposal at Alcatraz under Alternative E1 (section G.5.1.2) would be placed alternatively at the BFBA. The same volume of material slated for disposal at the ocean site (0.7 mcy) would also be used in this scenario. As described in section G.5.1.2, no significant water quality impacts are expected at the ocean site. Effects would be localized and short term. The placement of 4.8 mcy of sediment at the BFBA has also been discussed under the CAD alternative (section G.4.2). The volume of material under this scenario is equivalent to the placement of cap material under Alternative D1. As noted in section G.4.2, predictions of potential impacts on the water column have been modeled by the Corps. Based on their results, no significant water quality impacts in terms of toxic effects are expected during material disposal. With the exception of dissolved oxygen concentrations, water quality variables such as temperature, salinity, pH, and suspended solids are not expected to change beyond those limits defined by the RWQCB. Dissolved oxygen concentrations could decline below the minimum 5.0 mg/L requirement during disposal at certain times of the year. This effect would be localized and short-term. Significant impacts to the water quality, however, are not expected at the BFBA under this disposal scenario.

Upland disposal at the Galbraith Golf Course site could result in significant impacts on surface and groundwater quality, due to the release of salt, metals, tributyltin, and total PAHs, although such impacts are not expected.

G.5.2.3 Geology, Soils, and Seismicity

A sediment quality impact assessment for the ocean site under this scenario would follow that described in section G.2.2.3. Similar disposal volumes are proposed for this alternative and the one described in section G.2.2.3. The placement of 4.8 mcy of sediment at the BFBA, as discussed in the previous section, is equivalent to the placement of the capping material described in section G.4.3. The BFBA sediments show effects of anthropogenic input of certain contaminant constituents, and placement of materials deemed "suitable" for unconfined, open-water disposal would either maintain present sediment quality or improve it. No significant impacts to BFBA sediment quality under this alternative are expected.

Potentially significant seismic impacts may occur at the Galbraith Golf Course site if a large magnitude earthquake occurred on a nearby fault. In such an event, severe ground motion and liquefaction could occur. Earthquake-induced levee failure at the site could cause geologic hazards on surrounding features such as Doolittle Drive, the interior drainage canal, and the San Leandro Wastewater Treatment Plant.

G.5.2.4 Biological Resources

According to Alternative E2, Oakland Harbor material determined to be suitable for aquatic disposal would be disposed at the ocean site (0.7 mcy) and the BFBA (4.8 mcy). The types of potential impacts on the ocean site would be similar (but to a lesser extent) to those described in section 4.4 and G.2. Conditions occurring once the cap is in place (as described in section 4.4.3.3) are representative of those that would occur for Alternative E2 at the borrow pit. Because the material is considered suitable, no significant toxic effects on biota or bioaccumulation or biomagnification in the biota are expected to occur. Recolonization of the Bay Farm site would be relatively rapid and consist of a mixture of organisms currently existing at the borrow pit and those existing in adjacent areas to the borrow pit. Fish, birds, mammals, and threatened and endangered species may be temporarily affected but are not expected to be significantly impacted. Thus, no significant impacts on the biological communities present at the disposal sites are expected to occur.

At the Galbraith site, approximately 3.7 acres of seasonal freshwater marsh, tidal wetlands, and other waters of the United States (exact acreage to be determined by the Corps) would be filled. Seasonal ponding at the Galbraith site may result in an increase in mosquitos. Consultation with the Alameda County Mosquito Abatement District is recommended to mitigate this impact. Aquatic biota may be disturbed by pipeline construction and pumping operations, and may potentially be impacted by fuel spills or a break in the slurry pipeline. These impacts may be mitigated by setting anchors for the duration of the project; careful handling of fuel; and installation of a leak detection system on the pipe and/or monitoring of the slurry discharge. There is a potential for significant impacts on burrowing owls, if present, a species of special concern. Impacts may be mitigated to insignificance by relocating any owls and active burrows identified during a pre-construction survey. Significant impacts at this site are mitigable (see section 4.4.5.6).

G.5.2.5 Cultural Resources

No cultural resources are recorded in the ocean disposal site, the BFBA, or Galbraith. No impacts on cultural resources are therefore anticipated with this alternative.

G.5.2.6 Noise

Noise associated with use of the ocean disposal site would result from tugboats towing scows to the site. No noise impacts would result from disposing of dredge material at this site, since it is well removed from any sensitive receptors.

Noise associated with use of the BFBA would result primarily from tugboats towing scows to the disposal site. No noise impacts would result from disposing of dredge material at this site, since no sensitive receptors are present in the vicinity of the project.

At the Galbraith site, the unloader and booster pumps could cause potentially significant impacts depending on their placement. Impacts could be mitigated to insignificance if the pumps were placed sufficiently far away from sensitive receptors.

G.5.2.7 Transportation

The ocean disposal site is located outside of designated commercial vessel traffic lanes and away from any restricted passage areas, precautionary zones, or anchorages for commercial shipping. Project tugboats would represent additional vessel traffic within the project area. However, in relation to the volume of traffic in the San Francisco Bay area, the increase would be minor, and no significant impacts would occur.

The BFBA is not located within any major shipping channels, and impacts would be insignificant (PTI 1989).

Transport of dredged sediments from Oakland Harbor to the Galbraith Golf Course would be via tug-pushed scows and pipeline from either San Leandro Bay (Option A) or San Francisco Bay (Option B). Because of the shallow waters near the San Leandro shoreline, the tug-drawn scows could only navigate within three miles of the drying pond site. An offloading station would be constructed in the Bay to allow unloading of the sediments via hydraulic pipeline floating on the Bay. Approximately 19,000 round trips would be generated over a four-month period by the transport of levee material to the site. The local roadways can accommodate this short-term increase in traffic, however, and impacts to vessel and ground transportation would be insignificant.

G.5.2.8 Land Use Plans and Policies

No land use impacts *per se* would result from use of the ocean disposal site. It is located in the waters of the United States and is not subject to local land use plans and policies. The U.S. EPA and the Corps share responsibility for the management of ocean disposal of dredged material. With concurrence from the EPA, the Corps issues permits under MPRSA Section 103 for ocean disposal of dredged material deemed suitable according to EPA criteria in MPRSA Section 102 and EPA regulations in 40 CFR Part 227. Ocean disposal sites must be evaluated using EPA's ocean dumping criteria in 40 CFR Part 228. The ocean disposal site under consideration in this document was evaluated and found to satisfy both the general and specific criteria established by the EPA (1992).

The ocean disposal site is located in an area where some commercial and recreational fishing occurs. Previous studies (EPA 1992) have indicated that impacts would be insignificant due to the comparatively limited resources of the area, in addition to the fact that fish would avoid the disposal plumes. Since this disposal site lies outside of designated commercial shipping lanes, the increase in tugboat traffic would have no impact on commercial shipping.

No impacts to land uses would result from disposal at the BFBA. At the BFBA, impacts to commercial and recreational fishing would be short-term, localized, and insignificant. Most fish would be able to avoid the plume, and while some mortality may occur as a result of burial during disposal, it is expected to be minimal. No significant impacts to commercial shipping would result from use of this disposal site. Use of this site would be potentially inconsistent, however, with *San Francisco Bay Plan* dredging policies which require that dredged material be disposed of in ocean disposal or non-tidal sites unless such sites prove infeasible. It would also be potentially inconsistent with water quality policies of the *Bay Plan* due to short-term depletion of dissolved oxygen and the release of contaminants to the environment. The project could be brought into consistency through implementation of mitigation measures identified in this document, however.

Land use impacts at the Galbraith Golf Course are potentially significant due to the interim 7-year loss of the golf course at the site and displacement of the municipal soccer field at the site. The City of Oakland will construct a new soccer field at the Curt Flood Sports Complex in East Oakland, which will mitigate potential impacts from loss of recreational use of the existing soccer field by granting a lease to the City to develop another soccer field at the Port's North Airfield. Mitigation measures for the 7-year loss of the recreational use of the golf course will include development of a new golf course on site at the end of the 7-year interim construction phase, continuation of the youth golfing program, and subsidizing the cost difference for Oakland resident seniors to play at other golf courses until the new golf course is available.

G.5.3 Alternative E3 (Ocean, Alcatraz, and Leonard/Redwood)

G.5.3.1 Air Quality

Summaries of daily and total emissions that would occur from this alternative are provided in tables B-33 and -49, respectively. Project emissions would occur in Alameda, San Francisco, Sonoma, and Marin counties. As shown in Table B-33, daily project emissions of NO_x would exceed one percent of the combined emissions from these counties. Project emissions would also exceed the daily BACT trigger levels for all pollutants. These emissions would therefore be significant.

Project emissions would be spread over a large portion of the Bay Area region, between the Oakland Harbor, Leonard Ranch and Redwood landfills, Alcatraz Island, and offshore waters. However, since project emission sources would be mobile, pollutant impacts would not be large enough in a localized area to exceed any ambient air quality standard.

Project emissions would exceed AQMD significance thresholds for all pollutants. The effect of implementing the mitigation measures identified in section 4.1.4.1 are presented in tables B-33 and -49. These data show that mitigation measures would decrease project emissions, but only SO₂ emissions would be reduced to insignificance.

G.5.3.2 Hydrology, Groundwater, and Water Quality

This disposal alternative would result in no significant impacts to either the ocean site or Alcatraz waters. The volumes of material proposed for disposal under this scenario are 0.7 mcy at the ocean site and 4.8 mcy at Alcatraz. Potential impacts to the water column caused by the disposal of these proposed volumes of material was discussed in section G.5.1.2.

Use of the Leonard Ranch site would result in insignificant impacts on surface and groundwater, due to the release of salt. No significant impacts on surface and groundwater are expected at Redwood Landfill, due to the requirements of the landfill's operating permits.

G.5.3.3 Geology, Soils, and Seismicity

For reasons described in section G.5.1.3, no significant impacts to sediment quality at either the Alcatraz or ocean disposal sites are anticipated based on the proposed disposal volumes (4.8 and 0.7 mcy, respectively).

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Potentially significant seismic impacts may occur at the Leonard Ranch site, if a large magnitude earthquake occurred on a nearby fault. In such an event, severe ground motion and liquefaction could occur. Earthquake-induced levee failure at the site could cause geologic hazards on Highway 37 and the adjacent railroad tracks.

G.5.3.4 Biological Resources

For the Alternative E3 disposal plan, the quantity and proportions of dredged material to be disposed at the Alcatraz and the ocean disposal sites are the same as those defined for Alternative E1. As described above, only suitable Oakland Harbor sediments would be disposed at these sites. Impacts to the biota occurring at both the Alcatraz and ocean disposal sites are thus not expected to be significant. Use of the Leonard Ranch site under this alternative would result in the filling of 31 acres of seasonally inundated marshlands and 2 acres of ditches that presently contain freshwater wetland and aquatic habitats. Sensitive bird species nest in the salt marsh bordering San Pablo Bay and these species, if and where present, could be adversely affected by noise and activity associated with site construction and dredge disposal. These impacts could be mitigated to less than significant levels.

G.5.3.5 Cultural Resources

No cultural resources are recorded in the ocean disposal site, the Alcatraz site, or Leonard Ranch/Redwood Landfill. Because Leonard Ranch has not been surveyed, there is a potential for encountering cultural resources. Impacts on cultural resources are considered potentially significant with this alternative.

G.5.3.6 Noise

Noise associated with use of the ocean disposal site would result primarily from tugboats towing scows to the site. No noise impacts would result from disposing of dredge material at this site, since it is well removed from any sensitive receptors.

Noise associated with disposal at the Alcatraz site would result primarily from tugboats towing scows to the disposal site. It is located in the incoming traffic lane for San Francisco Bay. Due to the existing ship noise in the area and the distance to the nearest sensitive receptors, there would not be any noticeable change in noise at the sensitive receptors.

No significant noise impacts would result from use of the Leonard Ranch or Redwood Landfill sites.

G.5.3.7 Transportation

The ocean disposal site is located outside of designated commercial vessel traffic lanes and away from any restricted passage areas, precautionary zones, or anchorages for commercial shipping. Project tugboats would represent additional vessel traffic within the project area. However, in relation to the volume of traffic in the San Francisco Bay area, the increase would be minor, and no significant impacts would occur.

Scows would be towed by tugboat would be towed to the Alcatraz site, positioned, and dumped. The tug/scow combinations would travel a total distance of approximately 6 nautical miles each way. The

dredge scow path for this site involves crossing traffic lanes just east of Alcatraz on the outbound leg and south of the Bay Bridge on the inbound leg. These are relatively high risk maneuvers, but well established ones for the masters of the tugboats and scows. Additionally, this site has been used for many years, so that dredge disposal activities are known and expected. After previous dredged sediment disposal at this site, some shoaling has occurred, but this has not caused any significant impacts to navigation.

Dredged material would be transported to the Leonard Ranch site by scows towed by tugs. The tugs would use navigable channels through San Pablo Bay to deliver sediments to a point in the mouth of the Petaluma approximately 3,000 feet south of the Port Sonoma-Marin. The increase in vessel trips would be consistent with established movements. The offloading facility that would be constructed is located in a naturally wide and deep area and should not adversely affect local navigation.

Up to 1.2 mcy of dredged material could be dried at the Leonard Ranch site. The dried material would be transported to the Redwood Landfill. After the first year, material would be hauled by trucks. The project could increase the risk of accidents significantly on Landfill Road; additionally, increased traffic in the vicinity of the landfill would cause a significant impact. Mitigation measures such as avoiding peak hours and following an alternative route would reduce impacts to insignificance.

G.5.3.8 Land Use Plans and Policies

No land use impacts *per se* would result from use of the ocean disposal site. It is located in the waters of the United States and is not subject to local land use plans and policies. The U.S. EPA and the Corps share responsibility for the management of ocean disposal of dredged material. With concurrence from the EPA, the Corps issues permits under MPRSA Section 103 for ocean disposal of dredged material deemed suitable according to EPA criteria in MPRSA Section 102 and EPA regulations in 40 CFR Part 227. Ocean disposal sites must be evaluated using EPA's ocean dumping criteria in 40 CFR Part 228. The ocean disposal site under consideration in this document was evaluated and found to satisfy both the general and specific criteria established by the EPA (1992).

The ocean disposal site is located in an area where some commercial and recreational fishing occurs. Previous studies (EPA 1992) have indicated that impacts would be insignificant due to the comparatively limited resources of the area, in addition to the fact that fish would avoid the disposal plumes. Since this disposal site lies outside of designated commercial shipping lanes, the increase in tugboat traffic would have no impact on commercial shipping.

No impacts to land uses would result from disposal at the Alcatraz site. Use of this site for disposal of dredged materials is anticipated to have no significant impacts on commercial or sport fishing uses. Impacts to the fish community at Alcatraz are expected to be short-term and minimal. Fish should be able to avoid the site or tolerate disposal activities. No significant impacts to commercial shipping would result from use of this disposal site. Use of this site would be potentially inconsistent, however, with *San Francisco Bay Plan* dredging policies which require that dredged material be disposed of in ocean disposal or non-tidal sites unless such sites prove infeasible.

The Sonoma County General Plan discourages the conversion of such lands to non-agricultural use, but provides that public uses may be approved if an overriding public benefit exists. The proposed Leonard Ranch rehandling facility would be inconsistent with the General Plan's policy unless it can be

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demonstrated that the facility would constitute an overriding public benefit. The project may also be inconsistent with General Plan scenic resources policies. Use of the site would not significantly impact nearby land uses. No land use policy conflicts are expected from use of the Redwood Landfill site.

The proposed rehandling facility at the Leonard Ranch site would result in the loss of about 215 acres currently in agricultural production on Leonard Ranch and the loss of an undetermined amount in the northernmost parcel. A financial analysis is in progress; no significant land use impacts from loss of agricultural land have been identified to date.

G.5.4 Alternative E4 (Ocean, Borrow Area, and Leonard/Redwood)

G.5.4.1 Air Quality

Summaries of daily and total emissions that would occur from this alternative are provided in tables B-34 and -50, respectively. Project emissions would occur in Alameda, San Francisco, Sonoma, and Marin counties. As shown in Table B-34, daily project emissions of NO_x would exceed one percent of the combined emissions from these counties. Project emissions would also exceed the daily BACT trigger levels for all pollutants. These emissions would therefore be significant.

Project emissions would be spread over a large portion of the Bay Area region, between the Oakland Harbor, Leonard Ranch, Redwood Landfill, BFBA, and offshore waters. However, since project emission sources would be mobile, pollutant impacts would not be large enough to exceed any ambient air quality standard in a localized area.

Project emissions would exceed AQMD significance thresholds for all pollutants. The effect of implementing the mitigation measures identified in section 4.1.4.1 are presented in tables B-34 and -50. These data show that mitigation measures would decrease project emissions, but only SO₂ emissions would be reduced to insignificance.

G.5.4.2 Hydrology, Groundwater, and Water Quality

The potential impacts associated with maximum discharge of materials at unconfined disposal sites using a combination of the BFBA and the ocean site have been discussed in sections G.5.2.2 and G.5.2.3. Proposed material volumes for disposal are 4.8 and 0.7 mcy, respectively. No significant impacts to site waters are expected (see section G.5.2.2).

Use of the Leonard Ranch would result in insignificant impacts on surface and groundwater, due to the release of salt. No significant impacts on surface and groundwater are expected at Redwood Landfill, due to the requirements of the landfill's operating permits.

G.5.4.3 Geology, Soils, and Seismicity

Impacts to sediment quality at the BFBA and the ocean site are not expected to be significant under this disposal scenario (4.8 and 0.7 mcy at the BFBA and the ocean site, respectively). Sediment quality would either be maintained in its present condition or improved (see section G.5.2.3).

Potentially significant seismic impacts may occur at the Leonard Ranch site, if a large magnitude earthquake occurred on a nearby fault. In such an event, severe ground motion and liquefaction could occur. Earthquake-induced levee failure at the site could cause geologic hazards on Highway 37 and the adjacent railroad tracks.

G.5.4.4 Biological Resources

The amount of material to be disposed at the ocean site and BFBA in Alternative E4 is the same quantity as described for Alternative E2. As described above (section G.5.2.4), impacts on the biological community are expected to be insignificant.

Use of the Leonard Ranch site under this alternative would result in the filling of 31 acres of seasonally inundated marshlands and 2 acres of ditches that presently contain freshwater wetland and aquatic habitats. Sensitive bird species nest in the salt marsh bordering San Pablo Bay and these species, if and where present, could be adversely affected by noise and activity associated with site construction and dredge disposal. These impacts could be mitigated to less than significant levels.

G.5.4.5 Cultural Resources

No cultural resources are recorded in the ocean disposal site, the BFBA, or Leonard Ranch/Redwood Landfill. Because Leonard Ranch has not been surveyed, there is a potential for encountering cultural resources. Impacts on cultural resources are considered potentially significant with this alternative.

G.5.4.6 Noise

Noise associated with use of the ocean disposal site would result primarily from tugboats towing scows to the site. No noise impacts would result from disposing of dredged material at this site, since it is well removed from any sensitive receptors.

Noise associated with use of the BFBA would result primarily from tugboats towing scows to the disposal site. No noise impacts would result from disposing of dredge material at this site, since no sensitive receptors are present in the vicinity of the project.

No significant noise impacts would result from use of the Leonard Ranch or Redwood Landfill sites.

G.5.4.7 Transportation

The ocean disposal site is located outside of designated commercial vessel traffic lanes and away from any restricted passage areas, precautionary zones, or anchorages for commercial shipping. Project tugboats would represent additional vessel traffic within the project area. However, in relation to the volume of traffic in the San Francisco Bay area, the increase would be minor, and no significant impacts would occur.

The BFBA is not located within any major shipping channels, and impacts would be insignificant (PTI 1989).

Detailed Project Alternatives Analysis

Dredged material would be transported to the Leonard Ranch site by scows towed by tugs. The tugs would use navigable channels through San Pablo Bay to deliver sediments to a point in the mouth of the Petaluma approximately 3,000 feet south of the Port Sonoma-Marin. The increase in vessel trips would be consistent with established movements. The off-loading facility that would be constructed is located in a naturally wide and deep area and should not adversely affect local navigation.

Up to 1.2 mcy of dredged material could be dried at the Leonard Ranch site. The dried material would be transported to the Redwood Landfill. After the first year, material would be hauled by trucks. The project could increase the risk of accidents significantly on Landfill Road; additionally, increased traffic in the vicinity of the landfill would cause a significant impact. Mitigation measures such as avoiding peak hours and following an alternative route would reduce impacts to insignificance.

G.5.4.8 Land Use Plans and Policies

No land use impacts *per se* would result from use of the ocean disposal site. It is located in the waters of the United States and is not subject to local land use plans and policies. The U.S. EPA and the Corps share responsibility for the management of ocean disposal of dredged material. With concurrence from the EPA, the Corps issues permits under MPRSA Section 103 for ocean disposal of dredged material deemed suitable according to EPA criteria in MPRSA Section 102 and EPA regulations in 40 CFR Part 227. Ocean disposal sites must be evaluated using EPA's ocean dumping criteria in 40 CFR Part 228. The ocean disposal site under consideration in this document was evaluated and found to satisfy both the general and specific criteria established by the EPA (1992).

The ocean disposal site is located in an area where some commercial and recreational fishing occurs. Previous studies (EPA 1992) have indicated that impacts would be insignificant due to the comparatively limited resources of the area, in addition to the fact that fish would avoid the disposal plumes. Since this disposal site lies outside of designated commercial shipping lanes, the increase in tugboat traffic would have no impact on commercial shipping.

No impacts to land uses would result from disposal at the BFBA. Use of this site would be potentially inconsistent, however, with *San Francisco Bay Plan* dredging policies which require that dredged material be disposed of in ocean disposal or non-tidal sites unless such sites prove infeasible. It would also be potentially inconsistent with water quality policies of the *Bay Plan* due to short-term depletion of dissolved oxygen and the release of contaminants to the environment. The project could be brought into consistency through implementation of mitigation measures identified in this document, however.

At the BFBA, impacts to commercial and recreational fishing would be short-term, localized, and insignificant. Most fish would be able to avoid the plume, and while some mortality may occur as a result of burial during disposal, it is expected to be minimal. No significant impacts to commercial shipping would result from use of this disposal site.

The Sonoma County General Plan discourages the conversion of such lands to non-agricultural use but provides that public uses may be approved if an overriding public benefit exists. The proposed Leonard Ranch rehandling facility would be inconsistent with the General Plan's policy unless it can be demonstrated that the facility would constitute an overriding public benefit. The project may also be inconsistent with General Plan scenic resources policies. Use of the site would not significantly impact nearby land uses. No land use policy conflicts are expected from use of the Redwood Landfill site.

The proposed rehandling facility at the Leonard Ranch site would result in the loss of about 215 acres currently in agricultural production on Leonard Ranch and the loss of an undetermined amount in the northernmost parcel. A financial analysis is in progress; no significant impacts have been identified to date. The application for continued operation and expansion of the Redwood Landfill is currently undergoing environmental review.

APPENDIX H

U.S. Fish and Wildlife Service's Draft Coordination Act Report

The U.S. Fish and Wildlife Service's (USFWS) Draft Coordination Act Report (DCAR) was received by the Corps of Engineers on February 14, 1994. It is not included in its entirety in this appendix because of its volume (over 300 pages), much of which contains information that is redundant with information in this SEIR/S. The DCAR is located in the Environmental Branch of the Corps of Engineers, 211 Main Street, San Francisco, California 94105. This appendix does include verbatim the USFWS's recommendations for the tentatively selected plan (Alternative B2) as contained in the DCAR (pages 77-83 of the DCAR), and the U.S. Corps of Engineers' response to those recommendations. The DCAR is incorporated by reference in this SEIR/S. The USFWS, by letter dated May 20, 1994 (enclosed in this appendix), stated the Final CAR will be available on or before August 15, 1994.



United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
Sacramento Field Office
2800 Cottage Way, Room E-1803
Sacramento, California 95825-1846

May 20, 1994

Lt. Colonel Leonard E. Cardoza
District Engineer
U.S. Army Corps of Engineers
211 Main Street
San Francisco, California 94105-1905

Subject: CESF-Oakland Harbor Navigation Project

Dear Colonel Cardoza:

As you are aware, early in 1994 the Fish and Wildlife Service (Service) prepared draft and revised draft Fish and Wildlife Coordination Act (FWCA) reports for the Oakland Harbor Navigation Project. The revised draft report was the first opportunity for the various interested agencies to formally review the document.

The Service has received voluminous comments on the revised draft report and is now proceeding to prepare the final FWCA report. Due to the need to give full consideration to the large number and wide variety of comments received, we anticipate the final FWCA report will be transmitted to the Corps on, or before August 15, 1994. This is the date originally agreed upon by our respective staffs in the FY94 Scope of Work for this project.

The final FWCA report will address the review comments and other important developments which have occurred since the revised draft report was circulated for review. The most notable changes are: (1) the Service's letter dated March 23, 1994 which supports and encourages the State Coastal Conservancy's Sonoma Baylands tidal marsh restoration project, which now includes the creation of 24 acres of seasonal wetlands at the Sonoma Baylands disposal site, and (2) that the shallow subtidal (<20 feet deep) impacts from dredging at Oakland Harbor would be minimized by habitat values created by the network of shallow subtidal channels developing at the Sonoma Baylands Wetlands Demonstration Project.

Thank you for the opportunity to provide input to your planning process. If you have any questions please contact me or Jini Scammell-Tinling at (916) 978-4613.

Sincerely,

Joel A. Medlin
Joel A. Medlin
Field Supervisor

cc: FWS, ARD-ES, Portland, OR
FWS, SFO-ES, Wetlands Branch, Sacramento CA.
NMFS, Santa Rosa
EPA, Region IX, San Francisco (Attn: Brian Ross)
CDFG, Director, Sacramento
CDFG, Region III, Yountville (Attn: Carl Wilcox)
CDFG, Menlo Park (Attn: Bob Tasto)
California Coastal Conservancy, Oakland (Attn: Laurel Marcus)
BCDC, San Francisco
RWQCB, Oakland
Port of Oakland, Oakland (Attn: Jody Zaitland)

RECOMMENDATIONS

The Service's Mitigation Policy defines mitigation as including the following elements: avoiding impacts, minimizing impacts, rectifying impacts, reducing impacts over time, and compensating for impacts. The Service considers these elements to represent the most desirable sequence of steps in the mitigation planning process. In determining when to move from any one element to the next in the sequence, success or failure of particular techniques or approaches in the past under similar circumstances (as reflected in the results of previous mitigation evaluation studies) are taken into account.

The recommendations to offset impacts from the project contained within this section constitute what the Service believes, from a fish and wildlife resource perspective and consistent with our Mitigation Policy, to be the best present recommendations for the project. The outcomes of any new or renewed consultations, as required under Section 7 of the Endangered Species Act or Fish and Wildlife Coordination Act, could also affect the recommendations given herein. Rationales for many of the recommendations were discussed earlier within this report.

The Service relies upon internal guidelines (Federal Register 40(231):55818) when reviewing proposals for work and activities in or affecting navigable waters that are sanctioned, permitted, assisted, or conducted by the Federal Government. With respect to dredging and disposal of dredged materials the existing guidelines state that "in-bay, open water, and deep-water disposal generally will be considered acceptable to the Service only after all upland and other alternative disposal sites have been explored and rejected for good cause." Also, the Service's preferred disposal options are contingent upon several factors, most notably: (1) our present position regarding any further in-the-Estuary dredged material disposal, (2) the degree of contamination of the dredged sediments, and (3) the amounts of fish and wildlife habitats which would be potentially created and removed by each alternative. Wetland restoration projects will generally be supported if they have a high likelihood of creating a significant net gain of high-quality wildlife habitat, without degrading or removing any high-value or listed-species habitats, or otherwise reducing wetlands habitat values or acreages. Also, the Service will only support in-water disposal of sediments which meet established agency criteria, and assure full protection of fish and wildlife resources.

The Service recommends that the Corps of Engineers:

General Recommendations

1. Commit to using on all disposal alternatives listed for the project, appropriate sediment screening criteria, such as the "Green Book" and the RWQCB's criteria for wetland creation. Sediments for which suitability can not be agreed upon should be disposed of in the manner which would minimize detrimental impacts to fish and wildlife resources.

2. Develop a 20-year monitoring plan designed to determine success of the measures implemented to avoid, minimize, rectify, and/or compensate for impacts from whatever alternative or combination of alternatives is constructed. Monitoring and reporting would be required every year for the first 10 years and every 5 years thereafter. If, within the monitoring period, the wetland creation efforts are unsuccessful, corrective actions would be required until compensation goals are met. The annual report on the monitoring activities would be submitted by the local project sponsor to the Corps, the Service, and the California Department of Fish and Game. The Service and California Department of Fish and Game should have the opportunity to assist in developing the monitoring program.
3. Develop a final monitoring plan, subject to the review and approval of the Service, and the California Department of Fish and Game, before placement of any dredged materials on-site occurs. Components of this monitoring plan must include: (a) a field and/or lab determination of the bioaccumulation of trace metals and organochlorines in intertidal organisms, (b) quantification of wildlife activity, and (c) quantification of changes to adjacent outboard wetland habitats.
4. Revegetate the slopes of any dikes constructed with the project with native grass species to prevent erosion.

Specific Recommendations

A. Oakland Harbor

1. Dredge the contaminated areas first, followed by dredging of uncontaminated areas. This should effectively minimize any spread of unsuitable sediments to the new channel due to dredge action.
2. Develop disposal criteria (which are agreed upon by all the involved agencies and are based on the best available scientific information) for sediments which contain contaminants shown to bioaccumulate in test organism tissues. Any sediments for which a disposal methodology cannot be agreed upon by the involved agencies should be disposed of in a manner which least jeopardizes fish and wildlife resources of the disposal area.
3. Curtail dredging during the herring spawning season (December 1 through March 1) in harbor waters.
4. Curtail dredging operations, if necessary, during the least tern breeding season (May 1 through August 15) as mitigation if review and updating by the Corps of its previous reports and Biological Assessment(s) should show: (a) new information about the species that reveals effects not previously considered, or (b) the proposed action has been modified in a manner that would cause an effect not considered earlier.

5. Initiate, with the Port of Oakland, a program to monitor, regulate, and effectively prevent the influx of additional contaminants into Oakland Harbor to decrease impacts of future dredging, and to allow use of Oakland Harbor sediments for beneficial uses.
6. Provide, as compensation for the Port of Oakland dredging impacts, either 33 acres of "optimum" (one cover-type) replacement habitat using MEC (1991) alternatives or 17 acres of "optimum" (two cover-types) replacement habitat using either Sonoma Baylands or Montezuma Wetlands dredged material disposal options, as detailed in the HEP analyses (Appendix A).
7. Work cooperatively with all involved agencies to provide, as compensation for all Corps-permitted in-Bay dredging impacts, either 1,069 acres of "optimum" (one cover-type; using MEC (1991) alternatives) replacement habitat or 588 acres of "optimum" (two cover-types; using Sonoma Baylands or Montezuma Wetlands) replacement habitat, as detailed in the HEP analyses (Appendix A).

B. Disposal Alternatives

1. EPA Ocean Disposal Site

- a. If used as a disposal site, provide as compensation for the dredged material disposal impacts due to Oakland Harbor dredging, either 2.2 acres (one "optimum" cover-type) using MEC (1991) alternatives or 1.1 acres of "optimum" (two cover-types) replacement habitat, using either the Sonoma Baylands or Montezuma Wetlands dredged material disposal options, as detailed in the HEP analyses (Appendix A).
- b. Work cooperatively with all involved agencies to provide, as compensation for all impacts of disposal at the ODMDS, either 30 (two "optimum" cover-types; Sonoma Baylands or Montezuma Wetlands) or 60 acres of "optimum" (one cover-type; using MEC (1991) alternatives) replacement habitat as detailed in the HEP analyses (Appendix A).
- c. Develop, fund, and implement a detailed mitigation and monitoring plan for the ODMDS. Specific remedial and additional mitigation actions and/or curtailment of dredged material disposal should be included as aspects of this plan.
- d. Use water quality and biological data collected in the fall of 1993 (see contaminant section) by the U.S. Navy to develop an appropriate plan for disposal of Oakland Harbor sediments that best minimize fish and wildlife impacts.

2. Sonoma Baylands

- a. If used as a dredged material disposal site for the project, provide 85 acres, either on-site, off-site, or in combination, of seasonal wetlands to compensate for losses of seasonal wetland habitat values, as

specified in the HEP analyses (Appendix A). The amount of on-site acreage needed to offset losses of seasonal wetland values is dependent upon the location of setback levee construction at the site. All seasonal wetland values could be provided on-site by constructing the setback levee 235 feet away from the perimeter levee.

- b. Avoid construction work on levees adjacent to tidal wetlands (or laying of pipelines to convey dredged materials) during the California clapper rail nesting season (February 1 to August 31). Also, any pipelines should be located outside of habitats used by the clapper rail. Levee breaching should be designed to avoid affecting -- including any alteration of tidal influence -- habitat occupied by clapper rails.
- c. Minimize impacts in upland herbaceous areas not within the tidal inundation zone, including construction staging and access areas, by reseeding with native grasses and forbs as specified in the HEP (Appendix A). All disturbed levees and dikes in the area should be similarly reseeded.
- d. Increase the visibility of existing powerlines on the site by prominently marking them to minimize mortality and injury to waterfowl and raptors. Such modifications should occur prior to the placement of dredged materials on-site.
- e. Develop and implement detailed monitoring plans for: (i) dredge spoil placement, and (ii) seasonal wetlands, as detailed in the HEP analyses (Appendix A).
- f. Use only sediments for wetland cover that have mercury concentrations less than the rail reproductive toxic threshold of 0.2 mg/kg (dry weight), rather than the RWQCBs existing screening criteria of 0.35 mg/kg, and reassess the volume of material thus suitable for wetland cover at the site.
- g. Ensure, furthermore that the dredged materials used for restoring wetlands at the site show no significant bioaccumulation of contaminants relative to nearby reference wetlands, and have no contaminant concentrations greater than the RWQCB sediment screening criteria for cover materials, or greater than nearby reference wetlands, whichever would be more protective.

3. Galbraith Golf Course

- a. Take all feasible measures available to ensure that contaminated sediments or effluents are fully and permanently contained on-site. Lining the site with impermeable plastic materials would ensure that dredged material contaminants and effluents remain on-site.
- b. Cap contaminated sediments with "clean" (non-contaminated) fill material to avoid direct exposure to wildlife. Ensure that the thickness of the

cap be such that (i) exposure of the contaminated sediments due to water runoff and erosion is prevented during and after the site is reconstructed to a golf course, and (ii) deep enough to prevent or reasonably ensure burrowing animals do not penetrate contaminated soils.

- c. Offset adverse impacts to the existing seasonal wetlands on the golf course by developing 5.0 acres of seasonal wetlands on the reconstructed golf course as detailed in the HEP analyses (Appendix A).
- d. Minimize the adverse impacts to the upland area of the golf course by: (i) either of the two management options for the unaffected golf course area, or (ii) adding 2 acres more wetlands to the 5.0 acres in item "c" above. Details of all of these options are as the HEP analyses (Appendix A).

4. Montezuma Wetlands

- a. If used as a dredged material disposal site for the project, provide 481 acres (27.5 percent of 1,749 acres), either on-site, off-site, or in combination, of seasonal wetlands as mitigation for losses of seasonal wetland habitat values, as specified in the HEP analyses.
- b. Avoid construction work on levees adjacent to tidal wetlands (or laying of pipelines to convey dredged materials) during the California clapper rail nesting season (February 1 to August 31). Also, any pipelines should be located outside of habitats used by the clapper rail. Levee breaching should be designed to avoid affecting -- including any alteration of tidal influence -- habitat occupied by clapper rails.
- c. Minimize impacts in upland herbaceous areas not within the tidal inundation zone, including construction staging and access areas, by reseeding with native grasses and forbs as specified in the HEP (Appendix A). All disturbed levees and dikes in the area should be similarly reseeded.
- d. Develop and implement detailed monitoring plans for: (i) dredge spoil placement, and (ii) seasonal wetlands mitigation, as detailed in the HEP analyses.
- e. Adhere to recommendations 3.f. and 3.g. above for Sonoma Baylands; in addition, do not involve non-cover materials until further analysis of contaminant risks is completed on the 3-foot cover requirement, as requested in the contaminants section.
- f. Increase the visibility of existing powerlines through marking to minimize mortality and injury to waterfowl and raptors. Implement such modifications prior to the placement of dredged materials on the site.

5. Bay Farm Island Borrow Area

- a. Because of the relative paucity of information and many unanswered questions, as well as the fast planning track for the proposed project, remove this alternative from further consideration. BFBA could be considered later for maintenance dredging or other projects.
- b. If this alternative should nevertheless be selected at this time, the Corps should, as specified in the HEP analyses (Appendix A), (i) better assess the fate of the estimated 4 percent of unretained silts, clays, and associated contaminants, (ii) evaluate the contaminant concentrations of retained versus unretained fractions of disposed materials, and (iii) develop a detailed monitoring plan with management "trigger mechanisms."
- c. Also, if this alternative is selected at this time, the Corps should address in its EIS the following additional Service concerns: (i) the potential for porewater movement of contaminants, (ii) the influence of biological activity on cap and dike stability, (iii) the stability of cap material and dikes following seismic and large storm events; (iv) the influence of boat prop action on cap stability, (v) the influence of differential settlement on the confinement of contaminated materials, and (vi) the expected life of the dikes.

6. Leonard Ranch

- a. If used as a handling facility as proposed, acquire, create, and manage at least 47 acres of seasonal wetland habitat as specified in the HEPs for Leonard Ranch and Sonoma Baylands (Appendix A). Also, develop and implement a monitoring plan as specified in these HEPs.
- b. If used as a rehandling facility, minimize construction impacts to grassland/herbaceous cover-types, and reseed such areas that are affected, as specified in the HEP (Appendix A) for this alternative.
- c. Avoid construction work on levees adjacent to tidal wetlands (or laying of pipelines to convey dredged materials) during the California clapper rail nesting season (February 1 to August 31). Also, any pipelines should be located outside of habitats used by the clapper rail. Levee breaching should be designed to avoid affecting -- including any alteration of tidal influence -- habitat occupied by clapper rails.

7. Alcatraz.

- a. If used as a disposal site for the project, provide as compensation for aquatic and benthic impacts, either 354 acres (one "optimum" cover-type) using MEC (1991) alternatives, or 177 acres (two cover-types) of "optimum" replacement habitat, using the Sonoma Baylands or Montezuma Wetlands dredged material disposal options, as described and specified in the HEP analyses (Appendix A).

- b. Work cooperatively with all involved agencies to provide, as compensation for all cumulative in-Bay disposal at Alcatraz, either 2,947 (two "optimum" cover-types; using Sonoma Baylands or Montezuma Wetlands) or 5,984 acres (one "optimum" cover-type; using MEC (1991) alternatives) of replacement habitat, as specified in the HEP analyses (Appendix A).
- c. Participate in the design and funding of an evaluation and monitoring program to better refine the HEP analyses done herein (Appendix A), including better quantification of: (a) reduced habitat use, as a result of behavioral avoidance, (b) bay-wide deposition of contaminants, particularly in remote harbors, and (c) the approximate size of the sediment plumes, as a function of disposal frequency and volume.
- d. Halt all dredged material disposal at this site between December 1 and March 1 to avoid impacts to Pacific herring.

8. Port of Oakland Ninth Avenue Terminal.

- a. If used as a dredged material re-handling facility for the project, develop and implement a bird monitoring/hazing program as described in the HEP analyses (Appendix A).
- b. Develop and implement a water quality monitoring program as described in the HEP analyses (Appendix A).

9. Service's Preferred Alternative.

The Service's preliminarily preferred method of dredged material disposal for the Oakland Harbor Navigation Project is as follows:

- a. Maximize upland disposal of dredged materials to the greatest extent feasible using Galbraith Golf Course and the Port of Oakland's Ninth Avenue Terminal Facility, or other suitable upland sites.
- b. Use all remaining dredged material (meeting the Service's and the RWQCB's criteria) to the maximum extent feasible for tidal wetland restoration at Sonoma Baylands, Montezuma Wetlands, or other sites without impacting existing seasonal wetlands on these sites.
- c. Any remaining dredged material, which should be suitable for ocean disposal, should be disposed at the ODMDS.
- d. The Service objects to in-Bay disposal at the Alcatraz and Bay Farm Island Borrow Area for this project.

**Corps of Engineers Responses to the
U.S. Fish and Wildlife Service
Draft Coordination Act Report for the
Oakland Harbor Navigation Project
Dated January 1994**

The Service's DCAR includes the following recommendations that apply to the Corps' selected plan of dredging the Oakland Harbor channels with disposal of the dredged material at the following three sites: the Ocean Section 102 site located approximately 55 miles west of the Golden Gate; Sonoma Baylands in Sonoma County; and Galbraith Golf Course in Alameda County.

General Recommendations

1. Commit to using on all disposal alternatives listed for the project, appropriate sediment screening criteria, such as the "Green Book" and the RWQCB's criteria for wetland creation. Sediments for which suitabilities cannot be agreed upon should be disposed of in a manner which would minimize detrimental impacts to fish and wildlife resources.

Corps Response:

The appropriate sediment criteria, such as the "Green Book" and the RWQCB's criteria for wetlands have been and will continue to be used in selecting sediments suitable for unconfined aquatic disposal, wetland restoration, and upland disposal.

The suitability of the Port of Oakland sediments for wetland creation was investigated by the U.S. Army Engineer Waterways Experiment Station (WES) and reported in Lee et al. 1991. The wetland plant and animal bioassay tests conducted by the WES used one composite sample of Oakland Outer sediment to a depth of 42 ft, one composite sample of Oakland Inner Harbor sediment to a depth of 42 ft and one composite sample of Oakland Inner Harbor sediment to a depth of 39 ft. Wetland plants (*Spartina alterniflora*, *Spartina foliosa*, and *Salicornia subterminalis*) and animals (snails, *Nassarius* sp., mussels, *Modiolus* sp., and annelids, *Nephtys* sp.) were exposed to these sediments under controlled laboratory greenhouse conditions. An additional test was conducted in 1993 using snails and the clam, *Macoma nasuta*. The purpose of the tests were to determine if the Port of Oakland sediments were potentially toxic to wetland plants and animals and whether plants and animals would potentially become contaminated from the sediments placed under an intertidal wetland environment. At the same time, a field survey of existing wetland plants and animals in the San Francisco Bay area was conducted and reported in Lee et al. 1994. The purpose of the field survey was to establish baseline contaminant concentrations for existing wetland sediments, plants and animals for comparison to wetland creation testing of dredged material for San Francisco Bay.

Laboratory wetland bioassay test results indicated that Oakland Outer Harbor sediments can be used for wetland creation and will potentially produce plants and animals containing levels of contaminants similar to existing wetlands in the San Francisco Bay area. Both Oakland Inner Harbor sediments also produced plants and animals containing levels of most contaminants similar to existing wetland except for certain pesticides in wetland plants that could potentially reach FDA action levels for animal feed. In addition, the shallower Oakland Inner Harbor sediments to a depth of 39 ft showed bioaccumulation of tributyltin in snails, mussels and clams higher than that of animals exposed to existing wetland reference sediments. Clams showed bioaccumulation

of pyrene higher than clams exposed to existing wetland reference sediments at magnitudes of > 10 times, > 6 times and > 4 times for Oakland Inner Harbor (39ft), Oakland Inner Harbor (42ft) and Oakland Outer Harbor (42ft), respectively. Based on these test results, Oakland Inner Harbor sediments were not recommended for wetland creation as unrestricted cover materials but could be used as restricted noncover material that would be cover with more suitable material. Oakland Outer Harbor sediments were recommended as cover material for wetland creation. The growth of *Spartina alterniflora* in the plant bioassay was poor in Oakland Harbor sediments and was thought to be due in part to a possible zinc deficiency in the plants. Plants grown in Oakland Harbor sediments contained approximately 1/10 the normal content of zinc observed in existing wetlands.

Since these tests, it has been determined that only material that has been found suitable for wetland cover and unconfined ocean disposal will be proposed for wetland creation/restoration. Some of the sediments tested by the WES included material that has recently been determined to be unsuitable for unconfined aquatic disposal and unsuitable for wetland cover according to the interim sediment screening criteria. Consequently, the WES test results may be conservative and overestimate bioaccumulation in wetland plants and animals. Even so, Oakland Outer Harbor sediments produced plants and animals similar to existing wetlands in all but one PAH, pyrene, in clams and therefore, these sediments were recommended for use in wetland creation/restoration. It is reasonable to assume that by removing the more highly contaminated material from the material disposed at Sonoma Baylands, the levels of bioaccumulation in wetland species would also decrease. In short, the wetland restoration project with the proposed Oakland material should result in wetland conditions with equal or perhaps less bioaccumulation potential than existing natural wetlands in the San Francisco Bay area.

2. Develop a 20-year monitoring plan designed to determine success of the measures implemented to avoid, minimize, rectify, and/or compensate for impacts from whatever alternative or combination of alternatives is constructed. Monitoring and reporting would be required every year for the first 10 years and every 5 years thereafter. If, within the monitoring period, the wetland creation efforts are unsuccessful, corrective actions would be required until mitigation goals are met. The annual report on the monitoring activities would be submitted by the local project sponsor to the Corps, the Service, and the California Department of Fish and Game. The Service and California Department of Fish and Game should have the opportunity to assist in developing the monitoring program.

Corps Response:

See response to comment 3, below.

3. Develop a final monitoring plan, subject to the review and approval of the Service, and the California Department of Fish and Game, before placement of any dredged materials on-site occurs. Components of this monitoring plan must include: (a) a field and/or lab determination of the bioaccumulation of trace metals and organochlorines in intertidal organisms, (b) quantification of wildlife activity, and (c) quantification of changes to adjacent outboard wetland habitats.

Corps Response:

Draft monitoring plans are in preparation by the Corps (e.g., Sonoma Baylands and LTMS), the Environmental Protection Agency, and the Port of Oakland. A final monitoring plan will be developed in coordination with the Service and California Department of Fish and Game, as well as other concerned agencies such as EPA and RWQCB, prior to the placement of dredged material on the selected disposal sites. The scope, frequency, duration, and reporting requirements will be defined by the monitoring plan. Currently the LTMS upland studies group is preparing a draft monitoring plan for Sonoma Baylands.

4. Revegetate the slopes of any dikes constructed with the project with native grass species to prevent erosion.

Corps Response:

Levees constructed at the Sonoma Baylands and Galbraith Golf Course disposal sites will be seeded with native and/or naturalized grasses to prevent erosion.

Specific Recommendations

A. Oakland Harbor

1. Dredge the contaminated areas first, followed by dredging of uncontaminated areas. This should effectively minimize any spread of unsuitable sediments to the new channel due to dredge action.

Corps Response:

Dredging will be conducted in the most economically efficient and environmentally protective manner.

2. Develop disposal criteria (which are agreed upon by all involved agencies and are based on the best available scientific information) for sediments which contain contaminants shown to bioaccumulate in test organism tissues. Any sediments for which a disposal methodology cannot be agreed upon by the involved agencies should be disposed of in a manner which least jeopardizes fish and wildlife resources of the disposal area.

Corps Response:

Appropriate criteria (e.g., the "Green Book" and the RWQCB's criteria for wetland creation and Waste Discharge permit requirements) have been used in selecting sediments suitable for unconfined aquatic disposal, wetland restoration, and upland disposal. Dredged sediments will be disposed at approved locations in a manner which complies with the appropriate regulatory agency. The Corps is preparing dredging and dredged material disposal plans in association with the involved agency review.

3. Curtail dredging during the herring spawning season (December 1 through March 1) in harbor waters.

Corps Response:

The Corps will monitor, as needed, dredging activities in harbor waters during the herring spawning season (December 1 through March 1). Monitoring of dredging activities in the harbor waters does not mean curtailing of dredging activities in harbor waters during the December 1 through March 1 time period. The Corps will require a qualified marine biologist be on board the dredging plant during the December 1 through March 1 dredging time period. The marine biologist will be required to observe for herring spawning in close proximity to the dredging activity to ensure that the dredge plant maintains an acceptable (i.e. doesn't significantly disturb) distance from any current herring spawning activity, as well as, any previous (i.e., within the last two weeks) spawning site, since herring eggs are susceptible to smothering until they hatch. The marine biologist will submit daily reports to the Corps construction field superintendent to indicate time, location, whether any herring activity and how close to the dredge, and actions taken to minimize adverse impacts on spawning herring.

4. Curtail dredging operations, if necessary, during the least tern breeding season (May 1 through August 15) as mitigation if review and updating by the Corps of its previous reports and Biological Assessment(s) should show: (a) new information about the species that reveals effects not previously considered, or (b) the proposed action has been modified in a manner that would cause an effect not considered earlier.

Corps Response:

Any new information on the least tern not previously considered by the Corps and/or modification of the proposed action (i.e., the selected plan) will be cause for the Corps to address the selected plan as part of a new Section 7 Threatened and Endangered Species Act process.

5. Initiate, with the Port of Oakland, a program to monitor, regulate, and effectively prevent the influx of additional contaminants into Oakland Harbor to decrease impacts of future dredging, and to allow use of Oakland Harbor sediments for beneficial uses.

Corps Response:

The Port of Oakland has organized its tenants to obtain stormwater permits under the newly mandated, non-point source permitting system. That effort includes implementation of best management practices and monitoring the quality of stormwater runoff, and audits of tenants hazardous material handling. Most of the problems with dredged material discovered in testing appear to be associated with past disposal practices, particularly with shipbuilding and transportation of oil. Neither still occurs at the Port.

6. Provide as compensation for the Port of Oakland dredging impacts, either 33 acres of "optimum" (one cover-type) replacement habitat using MEC (1991) alternatives or 17 acres of "optimum" (two cover-types) replacement habitat using either Sonoma Baylands or Montezuma Wetlands dredged material disposal options, as detailed in the HEP analyses (Appendix A).

Corps Response:

Compensation for impacts associated with deepening already deepened and annually maintenance dredged channels is not justified. Those portions of the project that include channel widening and thus, first time dredging disturbance of shallow (defined as less than -20 feet MLLW) subtidal channel areas, represent approximately 4 acres. The Corps has no specific guidance or experience in compensation for shallow subtidal impacts. The Service has suggested some compensation measures but has not provided enough specifics for the Corps to evaluate and justify this recommendation.

7. Work cooperatively with all involved agencies to provide, as compensation for all Corps-permitted in-Bay dredging impacts, either 1,069 acres of "optimum" (one cover-type; using MEC (1991) alternatives) replacement habitat or 588 acres of "optimum" (two cover-types; using Sonoma Baylands or Montezuma Wetlands) replacement habitat, as detailed in the HEP analyses (Appendix A).

Corps Response:

This does not appear to be a project related impact. Compensation for non-project impacts are not justified.

B. Disposal Alternatives

1. EPA Ocean Disposal Site

- 1.a. If used as a disposal site, provide as compensation for the dredged material disposal impacts due to Oakland Harbor dredging, either 2.2 acres (one "optimum" cover-type) using MEC (1991) alternatives or 1.1 acres of "optimum" (two cover-types) replacement habitat, using either the Sonoma Baylands or Montezuma Wetlands dredged material disposal options, as detailed in the HEP analyses (Appendix A).

Corps Response:

Authority to include compensation in the Oakland project for impacts related to all ocean disposal activities is believed to be a U.S. Environmental Protection Agency (EPA) decision. The Service's recommendation will be forwarded to EPA for consideration in their rulemaking.

- 1.b. Work cooperatively with all involved agencies to provide, as compensation for all impacts of disposal at the ODMDS, either 30 (two "optimum" cover-types; Sonoma Baylands or Montezuma Wetlands) or 60 acres of "optimum" (one cover-type; using MEC (1991) alternatives) replacement habitat as detailed in the HEP analyses (Appendix A).

Corps Response:

The Corps continues to work cooperatively with all involved agencies to provide acceptable aquatic and upland dredged material disposal sites as part of the Long

Term Management Strategy (LTMS). The LTMS is a program which is designed to provide a regional plan for the disposal of up to 400 million cubic yards of dredged material from the San Francisco Bay over the next 50 years. LTMS is a Federal/State partnership between the four agencies that have regulatory authority for dredged material in the San Francisco Bay area: the Corps; the Environmental Protection Agency, Region IX; the San Francisco Bay Regional Water Quality Control Board (RWQCB); and the San Francisco Bay Conservation and Development Commission (BCDC). These four lead agencies share responsibility for managing the various components of the LTMS. One part of the LTMS structure includes an advisory group, the Policy Review Committee, which is comprised of a broad range of Federal, and State agencies, ports, development, environmental, and fishing interests. This committee meets quarterly and provides an important forum for public involvement in, and review of, LTMS development and implementation.

- 1.c. Develop, fund, and implement a detailed mitigation and monitoring plan for the ODMDS. Specific remedial and additional mitigation actions and/or curtailment of dredged material disposal should be included as aspects of this plan.

Corps Response:

See Corps response to Specific Recommendations number B.1.a. The EPA is developing a site management and monitoring plan for their to be designated ocean disposal site. The Corps will comply with the ODMDS management/monitoring plan as specified by EPA.

- 1.d. Use water quality and biological data collected in the fall of 1993 (see contaminant section) by the U.S. Navy to develop an appropriate plan for disposal of Oakland Harbor sediments that best minimize fish and wildlife impacts.

Corps Response:

The U.S. Environmental Protection Agency is giving full consideration to the water quality and biological data collected in the fall of 1993, by the U.S. Navy, in developing the conditions for general use of the ODMDS. The Oakland Harbor dredged material disposal plan will comply with any U.S. EPA use conditions.

2. Sonoma Baylands

- 2.a. If used as a dredged material disposal site for the project, provide 85 acres, either on-site, off-site, or in combination, of seasonal wetlands to compensate for losses of seasonal wetland habitat values, as specified in the HEP analyses (Appendix A). The amount of on-site acreage needed to offset losses of seasonal wetland values is dependent upon the location of setback levee construction at the site. All seasonal wetland values could be provided on-site by constructing the setback levee 235 feet away from the perimeter levee.

Corps Response:

(Note: The source for the Corps' responses to the Service's recommendations for Sonoma Baylands is the *Draft Demonstration Project Report and Environmental Assessment for the Sonoma Baylands Wetland Demonstration Project*, dated February 1994, San Francisco District, U.S. Army Corps of Engineers.) The Service used three Habitat Evaluation Procedure (HEP) species/guild models to evaluate changes in seasonal wetland values due to the Sonoma Baylands Wetland Demonstration Project. For two of the HEP seasonal wetland evaluation species, the wintering shorebird guild and the egret guild, the proposed restoration project would result in substantial gains in habitat value. The only HEP seasonal wetland evaluation species for which the Service calculated a loss of habitat value was wintering mallard. The Service calculated a loss of 6.85 average annual habitat units (AAHU's) for the wintering mallard, which was the smallest change for any of the six evaluation species used in the overall HEP.

Although the HEP model used by the Service for the wintering mallard assigns a habitat value to marshes, as well as to seasonal wetlands, the Service decided not to use the wintering mallard model in calculating the habitat value of the tidal salt marsh which would be restored at Sonoma Baylands. Using the Service's wintering mallard HEP model and the Service's assumptions regarding the progression of the marsh restoration, the Corps has calculated that the restored tidal salt marsh would provide approximately 158 AAHU's for wintering mallards. These 158 AAHU's were disregarded by the Service. The proposed restoration project would, therefore, actually provide a substantial net increase of approximately 151 AAHU's for wintering mallards, rather than the small decrease calculated by the Service.

The only functional value that the Service has identified for seasonal wetlands on the Sonoma Baylands site that would not be provided by restoring tidal wetlands is resting and feeding habitat for migratory waterbirds during high tide and storm events. There are abundant alternative seasonal wetland resting and feeding areas for migratory waterbirds adjacent to the Sonoma Baylands site. The loss of high tide resting and feeding habitat at the Sonoma Baylands site would affect migratory waterbird populations only if there is a future significant loss of other nearby seasonal wetlands. Existing Federal, State, and local laws, regulations, and policies are expected to prevent significant future losses of seasonal wetlands in the North Bay. Therefore, the loss of high tide resting and feeding habitat at Sonoma Baylands is not expected to have a substantial adverse effect on migratory waterbird populations.

As indicated by the Service's HEP analysis, the Sonoma Baylands Wetland Demonstration Project will result in substantial net gains in both wetland acreage and wetland habitat value. Therefore, compensation is not considered necessary for the restoration of the degraded former tidal wetlands on the Sonoma Baylands site to their original condition.

- 2.b. Avoid construction work on levees adjacent to tidal wetlands (or laying of pipeline to convey dredged materials) during the California clapper rail nesting

season February 1 to August 31). Also, any pipelines should be located outside of habitats used by the clapper rail. Levee breaching should be designed to avoid affecting -- including any alteration of tidal influence -- habitat occupied by clapper rails.

Corps Response:

Construction work on the bayfront levee and placement or removal of pipeline during the California clapper rail nesting season will be avoided, unless surveys by a qualified biologist indicate that clapper rails are not nesting within 500 feet of the construction area. Pipeline placement across the tidal wetlands will be restricted to the existing berm southwest of the pipeline site. The levee will not be breached during the California clapper rail nesting season, unless surveys by a qualified biologist indicate that clapper rails are not occupying areas that will be substantially affected by the alteration of tidal influence.

- 2.c. Minimize impacts in upland herbaceous areas not within the tidal inundation zone, including construction staging and access areas, by reseeding with native grasses and forbs as specified in the HEP. All disturbed levees and dikes in the area should be similarly reseeded.

Corps Response:

Levees constructed at the Sonoma Baylands site and other disturbed areas outside the tidal inundation area will be seeded with native and/or naturalized grasses and/or forbs to prevent erosion.

- 2.d. Increase the visibility of existing powerlines on the site by prominently marking them to minimize mortality and injury to waterfowl and raptors. Such modifications should occur prior to the placement of dredged material on-site.

Corps Response:

Marking of the existing powerlines to increase their visibility would eliminate an existing hazard to waterfowl and raptors, rather than any condition created by the proposed wetland restoration project. According to the Service's HEP analysis, the proposed restoration project will decrease the use of the site by waterfowl and raptors. Therefore, the restoration project would be expected to result in reduced mortality and injuries to waterfowl and raptors, even if the powerlines are not marked. Although the Corps does not believe that the project will result in reduced use of the site by waterfowl, the marking of the powerlines is considered a separate enhancement measure and is not proposed as part of the wetland demonstration project.

- 2.e. Develop and implement detailed monitoring plans for: (i) dredge spoil placement, and (ii) seasonal wetlands, as detailed in the HEP analyses (Appendix A).

Corps Response:

A plan will be developed and implemented for monitoring the placement of any dredged material. The plan will be a component of the plans and specifications for the dredging project. No monitoring plan for seasonal wetlands will be needed (see response to recommendation 2.a., above).

- 2.f. Use only sediments for wetland cover that have mercury concentrations less than the rail reproductive toxic threshold of 0.2 mg/kg (dry weight), rather than the RWQCBs existing screening criteria of 0.35 mg/kg, and reassess the volume of material thus suitable for wetland cover at the site.

Corps Response:

The average mercury concentration found in the surface soils of five existing tidal marshes in north San Pablo Bay in 1990 was 0.4116 mg/kg. The only area tested that had a mercury concentration below the Service's preliminary toxic threshold of 0.2 mg/kg was Dutchman Slough, north of Cullinan Ranch. All the other sites, including recently accreted marsh adjacent to the Sonoma Baylands site, had mercury concentrations exceeding 0.4 mg/kg. Reference samples of mudflat surface sediments collected south of the Sonoma Baylands site in 1992 had an average mercury concentration of 0.376 mg/kg. The mercury concentrations of sediments sampled from Oakland Harbor, and proposed for use in the tidal restoration project at Sonoma Baylands, ranged from 0.014 mg/kg to 0.331 mg/kg. These results indicate that the mercury concentrations of ambient suspended sediments in San Pablo Bay and some of the Oakland Harbor sediment exceed the RWQCB's screening criteria. Any wetland that is formed by the deposition of sediment from San Pablo Bay, whether by natural forces or by the placement of recently deposited sediment from a navigation channel including Oakland Harbor, will likely exceed the RWQCB screening criteria. Sediments from the Petaluma River channel tested in 1976 had an average mercury content of 0.4 mg/kg (dry weight). These data suggest that the ambient concentration of mercury in local sediments may have been fairly constant over the past two decades. Because the surface soil of the restored wetlands on the Sonoma Baylands will be formed by the deposition of suspended sediment from San Pablo Bay, there is no reason to restrict the allowable contaminant level in dredged material used for subsurface fill to levels below the level of contaminants found in the suspended sediments. Based on the available data, it appears that restoration of a tidal wetland is not physically possible under the present ambient conditions in north San Pablo Bay. While a reduction in the ambient level of contaminants could increase the reproductive success of clapper rails, it appears that clapper rails are able to reproduce under the ambient conditions. Therefore, the creation of additional breeding habitat is expected to increase the population of clapper rails, even though the ambient levels of contaminants in north San Pablo Bay may limit the reproductive success of the rails.

- 2.g. Ensure, furthermore that the dredged materials used for restoring wetlands at the site show no significant bioaccumulation of contaminants relative to nearby reference wetlands, and have no contaminant concentrations greater than the

RWQCB sediment screening criteria for cover materials, or greater than nearby reference wetlands, whichever would be more protective.

Corps Response:

Please see Corps response to General Recommendations Number 1.

3. Galbraith Golf Course

- 3.a. Take all feasible measures available to ensure that contaminated sediments or effluents are fully and permanently contained on-site. Lining the site with impermeable plastic materials would ensure that dredged material contaminants and effluents remain on-site.

Corps Response:

The Corps and the Port of Oakland have held a series of meetings with the Regional Water Quality Control Board to design containment facilities for the Galbraith Golf course. Both the dredged material and the underlying pore water in the landfill must be carefully controlled. Lining the site with impermeable layers without controlling seepage from the landfill would neither protect water quality nor be cost effective. The design for the containment facility will meet the concerns of the Regional Board and prevent significant impacts to either surface or groundwaters.

- 3.b. Cap contaminated sediments with "clean" (non-contaminated) fill material to avoid direct exposure to wildlife. Ensure that the thickness of the cap be such that (i) exposure of the contaminated sediments due to water runoff and erosion is prevented during and after the site is reconstructed to a golf course, and (ii) deep enough to prevent or reasonably ensure burrowing animals do not penetrate contaminated soils.

Corps Response:

Reference Corps response to Specific Recommendations number 3.a. Also, once dredged material is dry, the site will be covered with up to 2 feet of topsoil and landscaping, and will be managed as a golf course. The addition of dredged material will increase the buffer between wildlife and the former landfill underlying the site.

- 3.c. Offset adverse impacts to the existing seasonal wetlands on the golf course by developing 4+ acres of seasonal wetlands on the reconstructed golf course as detailed in the HEP analyses (Appendix A).

Corps Response:

The Port of Oakland will apply for a Corps permit for fill of the approximately 3.7 acres of seasonal wetland and open water that would be filled as part of the project. The Port will mitigate for this loss by creation of 4+ acres of new seasonal wetland on areas of the site unaffected by disposal.

- 3.d. Minimize the adverse impacts to the upland area of the golf course by: (i) either of the two management options for the unaffected golf course area, or (ii) adding 2 acres more wetlands to the 5.0 acres in item "c" above. Details of all of these options are as the HEP analyses (Appendix A).

Corps Response:

The golf course is an existing recreational facility with active management. Use of the upland portions of the site for dredged material disposal, or other uses is not a significant impact, and mitigation is unnecessary.

APPENDIX I

Department of Transportation Act Section 4(f) Evaluation Galbraith Golf Course Site

APPENDIX I

DEPARTMENT OF TRANSPORTATION ACT SECTION 4(F) EVALUATION GALBRAITH GOLF COURSE SITE

1.0 INTRODUCTION

The 4(f) Statement that follows was prepared pursuant to the requirements of the Department of Transportation (DOT) Act, 49 U.S.C. 303. DOT Section 4(f) states, in part, that:

It is the policy of the United States Government that special effort should be made to preserve the natural beauty of the countryside and public park and recreation lands, wildlife refuges, waterfowl refuges, and historic sites; and

The Secretary (of Transportation) may approve a transportation program or project (other than any project for a parkway under Section 204 of Title 23) requiring the use of publicly owned land of a public park, recreation area, or wildlife and waterfowl refuge of national, state, or local significance (as determined by the federal, state, or local officials having jurisdiction over the park, area, refuge, or site) only if (1) there is no prudent and feasible alternative to using that land; and (2) the program or project includes all possible planning to minimize harm to the park, recreation area, wildlife and waterfowl refuge, or historic site resulting from the use.

The requirement to prepare such an analysis was triggered by the consideration of the Galbraith Golf Course as a possible site for the disposal of dredged material from a deep-draft navigation improvements project at the Port of Oakland (Port), Alameda County, California. Recreational use of the site would be suspended for a period of five to seven years, but once the dredged material dried, the site would be regraded, and a new improved golf course would be constructed. The site is owned by the Port, but is legally part of the Metropolitan Oakland International Airport. The Port and the Federal Aviation Administration (FAA) agree that an Airport Layout Plan Review is not necessary for this project, but that an Airspace Review is required.

2.0 Background

Construction of the proposed navigation improvements to Oakland Harbor was authorized by the Water Resources Development Act of 1986. The Port is the non-federal (i.e., local) sponsor of the federal project. The proposed channel and berth improvements would involve the dredging and disposal of approximately 6.6 million cubic yards (mcy) of channel bottom sediments, including overdepth. The proposed dredging and disposal is anticipated to begin in December 1994 and last for 24 to 27 months. Additional detail concerning the dredging project is provided in section 2.0 of the SEIR/S.

The analysis of environmental impacts associated with the Oakland Harbor deepening project has proceeded over a number of years. The environmental effects of authorized channel improvements in the Port were thoroughly assessed in previous Final Environmental Impact Statements (FEIS). Various disposal options were evaluated in these documents but were ultimately withdrawn from consideration. This process is described in some detail below to provide evidence for the extent of the analysis of alternative disposal sites that previously has occurred.

The initial study for Oakland Outer Harbor, including a FEIS, was transmitted to Congress on February 1, 1985. Environmental impacts of the Outer Harbor project were assessed in the *Final Environmental Statement, Oakland Outer Harbor Deep-Draft Navigation Improvements, Alameda County, California*, which was filed with EPA on February 20, 1981. The feasibility study for Oakland Inner Harbor and FEIS was transmitted to Congress on January 26, 1985. The environmental impacts of the Inner Harbor project were assessed in the *Final Feasibility Study and Environmental Impact Statement, Oakland Inner Harbor Deep-Draft Navigation Improvements* which was filed with the EPA on April 18, 1985. Both projects were authorized for construction by the Water Resources Development Act of 1986 (Public Law 99-662) (COE 1988).

As originally authorized, disposal of the dredged material from the proposed project was to be at the Alcatraz Island aquatic disposal site, identified by the EPA as SF-11. Since 1982, when mounding of disposed dredged material at the Alcatraz site became apparent, and due to increased public concern about the impact of large-scale dredged material disposal events on the resources of San Francisco Bay, ocean disposal of Oakland Harbor dredged material was proposed in 1988. A Supplemental EIS (SEIS) was prepared to evaluate the impacts of direct ocean disposal and to designate for use an ocean disposal site under Section 103 of the Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972. Use of the ocean disposal site was given limited approval by EPA. The Record of Decision following the Final SEIS limited construction to only the "initial phase" (i.e., deepening the Inner Harbor channel from -35 feet MLLW to -38 feet MLLW) of the project with disposal of an estimated 500,000 cubic yards (cy) of material at an ocean site, and directed additional environmental documentation be prepared before construction of the remainder of the authorized project. The Record of Decision allowed limited construction because of the immediate need for the Port to accommodate larger deep-draft vessels.

After the Record of Decision was signed, the project was challenged in Federal Court by local fishermen, and construction of the reduced project was delayed. The Federal Court decided not to enjoin the project, and the local sponsor, by Section 215 Agreement (42 USCA sec. 1962D-5A) with the Corps, started construction in May 1988. A few days after this construction began, the project was enjoined in State Court by a suit brought by San Mateo County, and construction was stopped.

The Port decided to investigate the use of dredged sediments to reinforce levees in the Sacramento-San Joaquin Delta. Such a solution could allow disposal to occur more quickly than with ocean disposal, and would have the added advantage of providing a beneficial use of the material. In July 1989, the Port released a Final Supplemental EIR (FSEIR) that evaluated the environmental effects of placing the dredged materials from the first phase of the Inner Harbor deepening project on the inboard slopes of levees at Twitchell Island and Lower Jones Tract, both located in the Sacramento-San Joaquin Delta area, for levee reinforcement.

Following certification of the FSEIR, substantial problems arose when the Port attempted to obtain the necessary permits for utilization of the two levee sites. The Central Valley Regional Water Quality Control Board (CV-RWQCB) classified the Phase I dredged sediments as a "designated waste," contrary to the Port's position that the sediments were inert waste, due to ambient water quality (i.e., fresh water) at the proposed disposal sites. As a designated waste, the disposal of sediments for levee reinforcement was regulated pursuant to specific provisions under the California Code of Regulations, Title 23, Chapter 3, Subchapter 15. The CV-RWQCB issued a conditional permit for disposal with complex monitoring and related requirements. The Port's consultant, Harding Lawson Associates, estimated that the cost of monitoring for the first year after completion of dredging and disposal would be \$2.9 million for both

delta disposal sites. The annual cost of monitoring for subsequent years was estimated at \$1.0 million, and the CV-RWQCB retained the discretion to determine the duration of the monitoring program.

The affected counties also sought to regulate the disposal as a waste discharge activity and to require special land use permits with uncertain and potentially onerous requirements. Sacramento County indicated that their review process could be quite time consuming. In addition, the State Water Resources Control Board Resolution 68-18 established a non-degradation policy for maintaining water quality in California. Strict interpretation of this resolution could have precluded introduction of the Phase I sediments into the Sacramento-San Joaquin Delta due to potential salinity impacts to water quality.

The Port thus elected not to pursue these delta disposal options due to the costs and time that would have been associated with complying with the permit conditions of the CV-RWQCB and the escalating testing and monitoring requirements of Sacramento and San Joaquin counties.

Given the above constraints, a Supplemental Environmental Impact Report/Statement (SEIR/S) has been prepared that considers an ocean disposal site, several in-Bay disposal sites, and upland sites, including the Galbraith Golf Course.

3.0 THE PROPOSED AGENCY ACTIONS AT THE GALBRAITH GOLF COURSE

The Galbraith Golf Course would be used for disposal of sediments that are classified as suitable for upland disposal. This site is shown in Figure I-1. Up to 1.2 mcy of sediment could be disposed of at this site, depending on the disposal alternative selected (see section 5 below). The description of this site and how disposal would occur is based on Gin (1993). This site originally consisted of shallow tidal mud flats, marsh, and uplands adjacent to the Bay. The southwestern portion of the site was filled with municipal garbage. The remainder of the site received some hydraulic fill, overlain by more municipal garbage and demolition debris. Beginning in about 1965, the garbage and debris fills were graded to a relatively level configuration and blanketed with a thin layer of clayey soil and a golf course was constructed on top of the fill. Various types of soil and concrete/asphalt and brick rubble fills were reportedly used to construct many of the golf course landscape mounds. Currently, the site is underlain by Bay mud ranging in thickness from less than 1 foot at the northern edge (near Doolittle Drive) to more than 10 feet at the southern boundary.

A portion of the existing golf course would be cleared of all structures, utilities, landscaping, etc. A portion of the surface drainage channel that currently runs down the center of the site would be culverted. Dikes would then be constructed around the cleared portion of the golf course, and the dredged material would be pumped into the dike-enclosed areas. The dredged material would be mixed into a slurry and pumped, either from San Leandro Bay via the Airport Channel, or from a location in the San Francisco Bay southwest of the golf course (see Options A and B below). There would be a large pump at the offloading station, with additional booster pumps along the pipeline route to this site. Weirs (a device used to control the flow of water in an open channel) would be used to decant (i.e., draw off) the surface water from the top of the dredge slurry as the dredged material settles and consolidates. The decanted water would be retained behind the weir(s) until it meets RWQCB requirements for discharge into the Bay. After the removal of all surface water, a crust management program would be implemented to speed the drying of the deposited material, as described in section 2.3 of the SEIR/S. When the material was completely dry, the dikes would be lowered and the site regraded for the construction of a new golf



Figure I-1

PROPOSED DREDGED MATERIAL DISPOSAL AREA AT GALBRAITH GOLF COURSE

course. Use of this site for this sediment dewatering process could make the golf course unavailable for use for a period of 5 to 7 years. As noted above, the dredged sediment destined for this site might come from either San Leandro Bay (Option A) or San Francisco Bay (Option B), as described below.

3.1 Option A -- Pump Out from San Leandro Bay

Material dredged from Oakland Harbor that is unsuitable for unconfined aquatic disposal would be transported down the tidal canal using 3,000-cy dump scows (their effective capacity is assumed to be 2,400 cy). The tugs and scows would cross under four bascule bridges with a controlling height of approximately 18.4 feet above Port Datum (15.2 feet above mean sea level). Regardless of whether Option A or B were implemented, three scows would be used, with an empty scow being traded for a full one at the dredging site, and a full scow being traded for an empty one at the off-loading site. This could require one towing tug for transport of the scows and one tending tug at the dredger.

The scows would be unloaded using a modified suction dredge (16-inch or 20-inch) stationed as far down the tidal canal as the water depth would allow. The unloader would be secured in place using either spuds or a drop anchor. The dredged material would be mixed with water from the tidal canal, and pumped through a submerged pipeline down Airport channel to the channel's terminus. It would then be pumped through an at-grade (i.e., ground-level) pipeline to the golf course. This would require four road crossings (Doolittle Drive, Swan Way, Airport Road, and Airport Access Road). The crossing at Doolittle Drive would require jacking and boring under the roadway; the other three roadway crossings could be trenched. Because of the distance from the unloader to the golf course, a single booster pump might have to be installed along the pipeline, probably near the golf course.

The submerged portion of the pipeline would be placed closer to the northern bank of the airport channel. The pipeline would be marked and secured to minimize conflicts with recreational use of San Leandro Bay. The unloading station and booster pump would be insulated to reduce the volume of noise during pumping operations.

3.2 Option B -- Pump Out from San Francisco Bay

Under Option B dredged material would be transported to a hydraulic unloader stationed in San Francisco Bay, west of the Oakland Airport. The dredge slurry would then be pumped through a submerged pipeline to the airport dike. It would then be pumped through an at-grade pipeline along the dike to the golf course. Because of the distance from the unloader to the golf course, one or two booster pumps might have to be installed along the pipeline, probably on the airport dike and/or at the golf course. The unloading station would be located as close to shore as the water depth would permit in order to minimize the length of the pipeline.

As in Option A, the pipeline would be secured and marked. However, the open water location of the in-Bay loader would likely be a greater risk to exposure during inclement weather. Also, because of the limited depth of the Bay west of the airport, the unloader would be stationed near (but within) the Oakland city border.

3.3 Sediment Deposition

Because the site is underlain by Bay mud, some settlement of the site would be likely due to the weight of the dikes and dredged material. The site is likely to settle about 2 to 4 feet under the dikes and 1 to

3 feet under the dredged material. Primary settlement would occur within 18 months of dredged material placement. To compensate for this, the dikes would be constructed to a crest elevation 1 to 2 feet above the planned long-term crest elevation. Stability considerations would limit the crest elevation to +28 feet MLLW.

An approximately 100-acre drying pond would be constructed on the site (Figure I-1). The pond would be surrounded by dikes with 10 to 15-foot-wide crests, about 20 feet high. The dikes themselves would occupy approximately 30 additional areas. The potential capacity of the site would be approximately 1.3 mcy of dredged material.

The dikes would be constructed from material that would be trucked onto the site, with the possible limited use of some of the material comprising the golf course landscaping mounds. Potential sources of material include: Berth 30 excavation material currently stockpiled at various locations within the Port area; material from the Leona Quarry in the Oakland foothills; or certified clean material that would be provided by the construction contractor. Approximately 228,000 cy of material would be necessary for construction of the dike.

Some small isolated wetlands on the Galbraith site would be filled with the proposed project. A portion of the existing drainage channel in the middle of the site, which is also regulated by the Corps under the Clean Water Act, would be culverted. The loss of these wetland areas would be mitigated by the expansion of existing wetlands (1) in the northwest corner of the site, and (2) parallel to Airport Drive (Figure I-1), which will not be affected by the disposal operation.

After all surface decant water had been removed, a crust management program would be implemented to speed the drying process. A crust management program would involve working the material, first with a drag line (an excavator equipped with a crane boom) operated from the top of the containment dike, then with lightweight earthworking equipment, to expose the deeper, wet material to the desiccating (i.e., drying) action of the sun and wind. Initially, the material would be too deep and "soupy" to take any equipment out into the cells. Consequently, the first step in the management program would be to dig perimeter trenches with a drag line (an excavator equipped with a crane boom) operated from the crest of the dike. The trenches would facilitate draining additional free water from the material, accelerating the natural drying process. Once the material was dried enough to take lightweight earthworking equipment (e.g., a lightweight "mudcat" equipped with balloon tires) on the site without having the equipment sink into the mud, the relatively dry surface crust would be scraped and trenched in order to further expose the underlying wet material to the sun and wind. The frequency of this operation would depend on atmospheric conditions (temperature, humidity, wind). During the typically dry and windy early fall, the material could be worked once a week (a day to a day-and-a-half per cell); whereas during the rainy season, the material might not be worked even once a month. Care would be taken during the rainy season to grade the site to prevent or minimize rainwater retention and possible erosion of the material. Subsurface drainage wicks could also be used to speed the drying process.

The Port has agreed to construct a new public golf course on top of the dredged material, once dry. Thus, loss of the recreational use of the site will be temporary. The new course will be leased on a long-term basis (66 years) to the City of Oakland. Topsoil will be imported to construct the surface of the new golf course.

4.0 IMPACTS TO THE 4(F) PROPERTY AND MITIGATIONS

Use of the Galbraith Golf Course would preclude its current use as a recreational site for a period of five to seven years. Once the deposited material was completely dry, the dikes would be lowered, and the site would be regraded for the construction of a new golf course. Thus, the site would be removed from recreational use, but the loss of the use would not be permanent, and ultimately, an improved recreational facility would be constructed. The project would result in significant, short-term construction impacts to air quality, and longer-term impacts to hydrology, geologic hazards, biological resources, noise, and land use. All of these impacts are mitigable to insignificant levels, with the exception of air quality and land use (recreation). (It should be noted, however, that each of the project alternatives considered would have unmitigable air quality impacts.) These impacts are described in Table I-1, along with recommended mitigation measures and significance after mitigation. They are described in greater detail in their respective sections of the SEIR/S.

5.0 ALTERNATIVES ANALYSIS

This section presents an overview of the individual alternative disposal sites that were considered in addition to the Galbraith Golf Course as well as the combinations of alternative sites that were considered. The sites considered include a number that were recommended by the LTMS as highly feasible (Moffatt & Nichol 1993), as well as over 30 sites considered in a previous study (Tetra Tech Inc. 1990) for disposal of sediments that were excavated during the construction of most of the Inner Harbor to -38 feet MLLW. The latter study screened sites based upon capacity, engineering constraints, ownership, and ability to receive material within the timeframe of the proposed dredging project.

Sites that were originally considered are shown in Figure I-2. A number of these sites were eliminated from further consideration due to a variety of reasons, including limited capacity, inconsistency with plans and policies, length of time required to prepare the site, impacts to wildlife and wetlands, cost, and preemption by another dredging project. A more detailed discussion of the alternatives limited from further consideration is provided in section 2.6 of the SEIR/S.

5.1 DREDGED MATERIAL DISPOSAL SITES CONSIDERED FOR FURTHER STUDY

After the elimination of disposal options described above, eight disposal sites remained for further consideration, including three aquatic sites and five upland sites. These sites are shown in Figure I-3 and briefly described below. More detailed discussion is provided in section 2.7 of the SEIR/S. The type of sediment that would go to each site is summarized in Table I-2. The amount of dredged sediment that would go to each site depends on the disposal alternative considered (see discussion below). An almost unlimited combination of disposal plans are possible by varying slightly the volume of sediments proposed for each disposal option. The alternatives selected for detailed analysis in this document were selected to encompass the range of possible combinations.

Ocean Section 102

The Environmental Protection Agency (EPA) Ocean Section 102 site is the same as Alternative Site 5 in the EPA's FEIS. Up to 5.4 mcy of sediment could be disposed at this site, depending on the disposal alternative selected. Disposal at this site would require one clamshell dredge, two tugs, and four dump scows. Sediments would be released by bottom dump barge.

Table I-1. Project Impacts at the Galbraith Golf Course
(page 1 of 3)

Resource	Significant Impact	Mitigation Measure	Significance after Mitigation
Air Quality	Exceedance of AQMD Best Available Control Technology thresholds for total organic gases (TOG), and oxides of nitrogen (NO _x).	Retard injection timing of diesel-powered equipment for NO _x control and use of reformulated diesel fuel for TOG/ROG control.	Impacts reduced but not to insignificance.
	Excessive fugitive dust generation.	When necessary, apply a soil binding agent, such as water, during construction or when large amounts of bare soil are exposed.	Insignificant.
		When necessary, cover trucks with tarpaulins or an equivalent method.	
Hydrology	Significant impacts on groundwater quality could occur due to the lateral migration of existing leachate fluids containing petroleum products.	Design containment structures to meet RWQCB requirements.	Insignificant.
	Discharge of surface water may exceed water quality standards.	Monitor effluent. Place vegetative control areas outside of drying ponds to increase sedimentation and provide natural treatment for metals. If effluent exceeds RWQCB standards, hold decant water in ponds until standards met.	Insignificant.
	Placement on site of sediments containing elevated levels of contaminants exceeding levels acceptable to the RWQCB.	Conduct additional sampling after the dredged material dries to confirm that there are no "hot spots" present.	Insignificant.

Table I-1. Project Impacts at the Galbraith Golf Course
(page 2 of 3)

Resource	Significant Impact	Mitigation Measure	Significance after Mitigation
Geology, Soils, and Seismicity	If a large magnitude earthquake occurred on a nearby fault, earthquake-induced levee failure could cause geologic hazards on surrounding features such as Doolittle Drive, the interior drainage canal, and the San Leandro Wastewater Treatment Plan.	Design levees using standard geotechnical engineering practices to prevent catastrophic impacts on adjacent facilities in the event of failure.	Insignificant.
Biological Resources	Loss of approximately 3.7 acres of seasonal freshwater marsh, tidal wetlands, and other waters of the United States (exact acreage to be determined by the Corps).	Avoidance to reduce loss. Compensatory on-site mitigation for wetlands that cannot be avoided at a ratio of 1.1:1 to 1.3:1 on an acreage basis.	Insignificant.
	Seasonal ponding may increase mosquitos.	Consult with the Alameda County Mosquito Abatement District.	Insignificant.
	Disturbance of aquatic biota by pipeline construction and pumping operations; potential impacts from fuel spills or a break in the slurry pipeline.	Set anchors for the duration of the project; careful handling of fuel; install leak detection system on the pipe and/or monitor slurry discharge.	Insignificant.
	Potential impact on the burrowing owl, if present.	Preconstruction survey and removal of burrows if present.	Insignificant.

Table I-1. Project Impacts at the Galbraith Golf Course
(page 3 of 3)

Resource	Significant Impact	Mitigation Measure	Significance after Mitigation
Noise	The unloader and booster pumps could cause excessive noise, depending on their placement.	Locate pumps so that noise does not exceed 60 dBA between 7 A.M. and 10 P.M. and 50 dBA between 10 P.M. and 7 A.M.	Insignificant.
Land Use	Loss of golfing recreational uses during the 7-year interim construction phase.	Allow for continuance of youth golfing program. Subsidize senior golf club, and Oakland senior use of nearby golf course.	Significant.
	Loss of municipal soccer field on the Galbraith Golf Course site.	The City of Oakland will construct a new soccer field at the Curt Flood Sports Complex in East Oakland.	Insignificant.

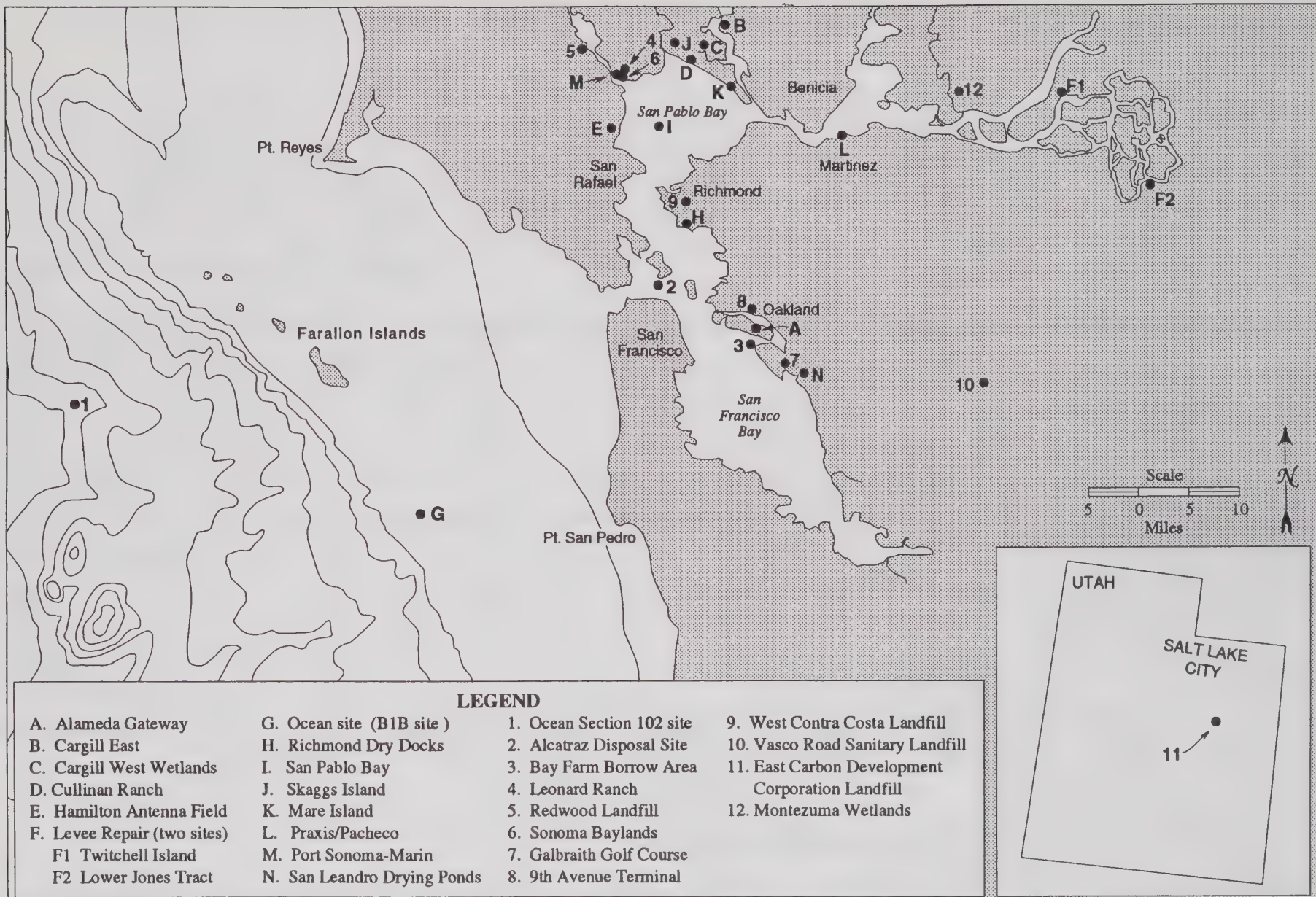


Figure I-2

DREDGED MATERIAL DISPOSAL OPTIONS INITIALLY CONSIDERED

Table I-2. Suitability of Oakland Harbor Sediments for Various Disposal Options

	Dredged Material Disposal Sites							
Sediment Categories*	Ocean Section 102 Site	Alcatraz	Bay Farm Borrow Area	Leonard Ranch/ Redwood Landfill	Sonoma Baylands	Galbraith Golf Course	Port/ Landfill	Montezuma Wetlands
Suitable for Unconfined Ocean Disposal	X							
Suitable for Unconfined In-Bay Disposal		X	X					
Suitable for Confined In-Bay Disposal			X					
Suitable for Wetland Cover					X			X
Suitable for Wetland Non-Cover								X
Suitable for Upland Disposal				X		X		
Requires Landfill Disposal							X	

Note: *Sediment categories are not mutually exclusive.

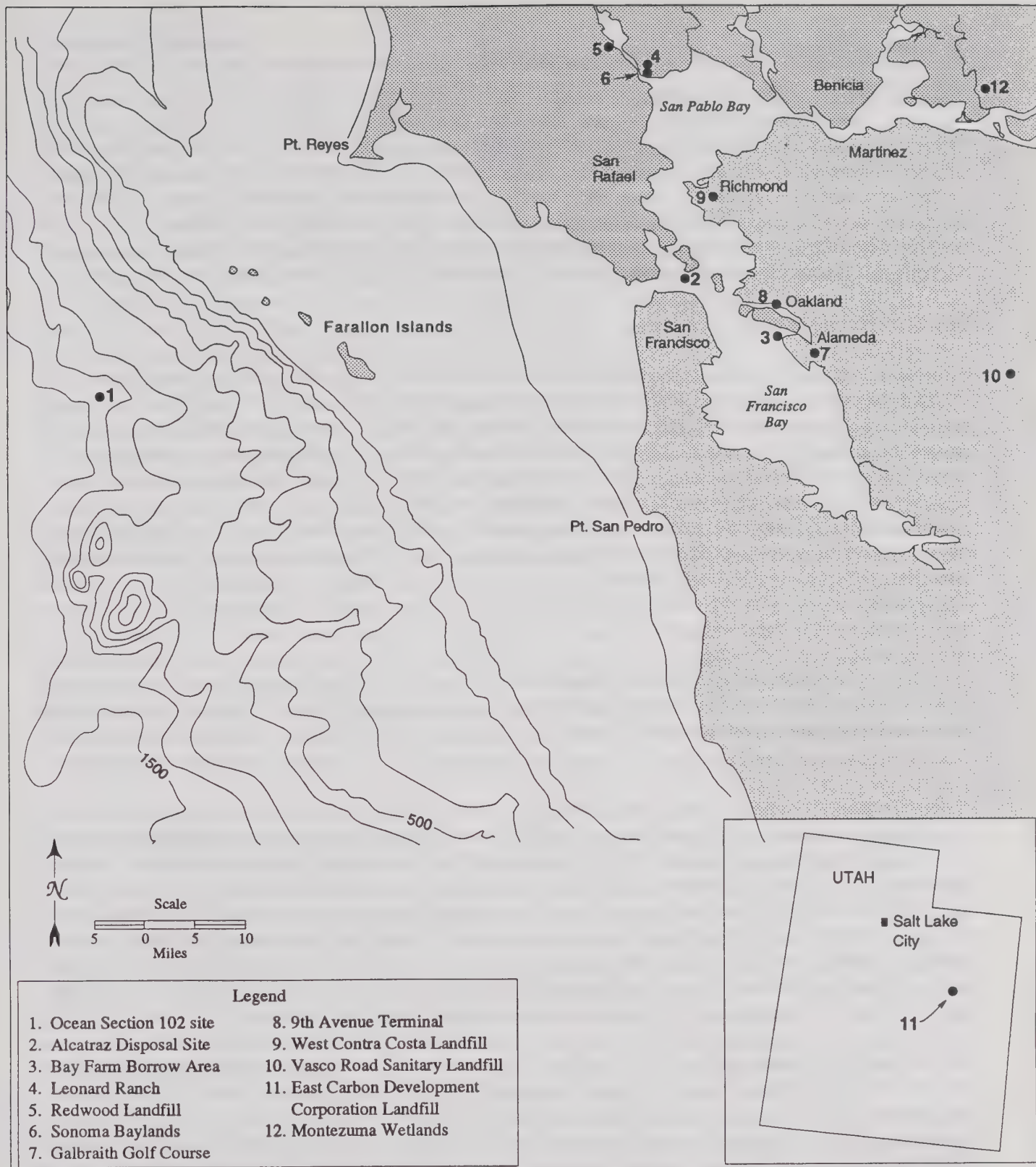


Figure I-3

DREDGED MATERIAL DISPOSAL SITES EVALUATED IN DETAIL

Alcatraz

Either none or 4.8 mcy of sediment could be disposed of at this site, depending on the disposal alternative selected. Disposal at this site would require one clamshell dredge, two tugs, and three dump scows. Sediments would be released by bottom dump barge. There are monthly and annual "target restrictions" on the amount of sediment that can be disposed of at this site. The annual restriction is 4 mcy. The monthly restriction is 400,000 cy from October through April, and 300,000 cy from May through September; during either of these two periods, no more than 150,000 cy may be clamshelled material.

Bay Farm Borrow Area

Either 4.8 or 6.6 mcy of sediment could be disposed of at this site, depending on the disposal alternative selected. Disposal at this site would require one clamshell dredge, two tugs, three dump scows, and possibly a pump-out barge. Sediments disposed at the Bay Farm Borrow Area would be released by controlled, submerged pipelines and/or directly from dump scows, depending on the disposal alternative selected. For confined disposal, unsuitable material would first be released directly from dump scows, and then suitable material would be placed over the unsuitable material by submerged pipelines. For unconfined disposal, suitable material would be released directly from dump scows. ("Suitable material" means material suitable for unconfined aquatic disposal, and "unsuitable material" means material unsuitable for unconfined aquatic disposal.)

Leonard Ranch/Redwood Landfill

This disposal option could be used for disposal of 0.2 to 1.2 mcy of sediments that are unsuitable for ocean disposal. The sediments would be dried over approximately 188 acres of the 230-acre Leonard Ranch site, and then hauled by truck to Redwood Landfill approximately 12 miles away by road in Marin County for use as either daily cover or construction material.

Under this option, sediments would be dredged from the Oakland harbor by either a clamshell dredge or hydraulic cutterhead dredge and loaded onto 3,000 to 4,000 cy capacity barges. Filled barges would be towed approximately 16 miles to the unloading point in the vicinity of the Petaluma River Channel entrance. The dredged material would then be pumped through a floating pipeline as a slurry approximately 10 miles onto land, using a modified hydraulic dredge to the Leonard Ranch site. Once on land, the pipeline would follow a route along an area of existing upland vegetation, then continue along an existing access road, and then finally cross beneath the Northwestern Pacific railroad track through an existing culvert to reach the Leonard Ranch site. The material slurry would be about 15-20 percent solids. All waterborne off-loading equipment would be moored on spuds.

Levees would be constructed on the rehandling site to contain the dredged material as it dries. An interior dike would be constructed to provide access to the existing Pacific Gas & Electric (PG&E) towers that traverse the site. The levees would be constructed with on-site materials. Construction of the rehandling facility is estimated to take 3 months.

Water decanted from the drying basin would be discharged over a weir into a separate effluent control basin. From this basin, the discharge water would be directed through a culvert beneath the railroad bed into the existing drainage channel, and eventually into the Bay. The effluent control basin would be designed to allow sufficient settling (and treatment, if required) to meet RWQCB requirements for discharge to the Bay. The dredged material would be moved from the site to Redwood Landfill in stages

as it dries. Depending upon the volume of sediments, climatic conditions, and the degree of material handling, all the dredged material would be expected to dry within 2 to 4 years of disposal.

Sonoma Baylands

This option would use 2.5 mcy of the dredged sediments that meet the RWQCB's (1992) requirements for wetland creation and that are also suitable for ocean disposal to restore tidal wetlands over 289 acres of a 348-acre site in southern Sonoma County. Information concerning this alternative is derived from COE (1994). The property is diked, subsided, former tidal wetlands, which is presently used for agriculture and supports some seasonal wetlands. The property was recently purchased by the Sonoma Land Trust, with funding from the California Coastal Conservancy.

The implementation of the Sonoma Baylands project was authorized by Congress under Section 106 of the Water Resources Development Act (WRDA) of 1992. Under this Act, the Corps was directed to use ". . . dredged material suitable for aquatic disposal to restore, protect, and expand the Sonoma Baylands for the purposes of preserving waterfowl, fish, and other wetland dependent species of plants and animals and to provide flood control, water quality improvement, and sedimentation control." Additional purposes specified in the WRDA are to restore tidal wetlands, provide habitat for endangered species, expand the feeding and nesting areas for waterfowl along the Pacific flyway, and demonstrate the use of suitable dredged material as a resource, facilitating the completion of San Francisco Bay Area dredging projects in an environmentally sound manner. The Congressionally authorized project requires a 25 percent non-federal cost-share for construction, monitoring, and any necessary remediation. The non-federal sponsor (in this case, the State of California) would also be responsible for operation and maintenance of the completed project. It is anticipated that the California Department of Fish and Game will assume responsibility for long-term management of the site. The purpose of the evaluation in this SEIR/S is to address the implementation of the Sonoma Baylands project using sediments from the Oakland harbor deepening project.

Site preparation is estimated to take 5 months. A new perimeter levee on the west, north, and east sides of the property would be constructed to protect adjoining properties and the adjacent railroad from flooding. A series of interior peninsulas would be constructed to (1) enhance the sedimentation rate on the site by reducing the wind fetch, and (2) protect the interior slopes of the perimeter levee from wave erosion. The top of the levee would be constructed to 8 feet above NGVD (refers to 1929 National Geodetic Vertical Datum) after settlement. Levee construction would require about 700,000 cy of material that would be excavated on-site. The levee would be constructed approximately 100 feet inboard of the existing drainage ditch at the edge of the property. The California Coastal Conservancy is also proposing that the approximately 24-acre area between the new levee and the ditch be converted to seasonal wetland by construction of a small berm to retain local precipitation, and compaction of the underlying soil.

Under this option, it is assumed that sediments would be dredged from the Oakland Harbor by either a clamshell dredge or hydraulic cutterhead dredge and loaded onto 3,000 - 4,000 cy capacity barges. Filled barges would be towed to the unloading point in the Petaluma River Channel. The dredged material would then be pumped to the Sonoma Baylands site as a slurry through a floating pipeline using a modified hydraulic dredge. Once on land, the pipeline would follow a route along an area of existing upland vegetation. The material slurry would be 15-20 percent solids. All waterborne off-loading equipment would be moored on spuds. Dredging and disposal is estimated to last for up to 21 months.

The dredged material would be placed hydraulically so that the surface elevation of the site, prior to opening to tidal flushing, would be about +2.0 feet above NGVD, which is below the elevation normally occupied by tidal marshes. Natural sedimentation would be expected to continue to raise the surface elevation, and a tidal marsh would be expected to develop within approximately 10 years, when suitable elevations exist.

Releases of decanted water from the dredged material slurry would be controlled by spillways at three locations in the existing outboard levee. Discharges through the spillways would be monitored to ensure that sufficient retention time occurs for fine-grained particulates to settle out. Discharges during construction would be controlled until the water meets RWQCB discharge requirements. To guard against exposing the dredged material to the air and causing oxidation and acidification, the material would never be dried out. A layer of water would cover the material until the tide is introduced to the site. Approximately six months following the placement and consolidation of the dredged materials, the southern perimeter levee would be breached at two locations to initiate tidal circulation.

Montezuma Wetlands

The Montezuma Wetlands site is situated near Collinsville in Suisun Marsh in Solano County. It is bordered on the south by the Sacramento River, on the west by the Montezuma Slough, on the north by the Potrero Hills, and on the east by the Montezuma Hills. The site is located at the eastern edge of the marsh system about 17 miles southeast of Fairfield. Vehicle access is via State Route 12, Shiloh Road, Birds Landing Road, and Collinsville Road. A total of 6.4 mcy of sediment could be disposed of at this site. Levine-Fricke proposes to create a tidal wetland at this site by placing a total of approximately 20 mcy of dredged materials, taken from as yet undesignated areas in San Francisco Bay, over approximately 1,800 acres of the 2,000-acre site. An Administrative Draft EIR/S (ADEIR/S) is in preparation for this Montezuma Wetlands Project (Solano County 1993), and site-specific details are currently being developed. The preliminary draft of that document serves as the basis for the following description, the description of the affected environment in Chapter 3 of the SEIR/S, and the impact assessment for this site in Chapter 4 of the SEIR/S.

The Montezuma Wetlands Project consists of four phases. There is a specific area of the site associated with each phase, and the phases would be developed sequentially. Oakland Harbor sediment would be deposited only in the Phase I area, which has the capacity of more than 7 mcy. Phase I is intended by the applicant to offset some of the impacts of the subsequent three phases. The four phases are hydrologically independent and semi-autonomous. Each phase would be filled with dredged sediment independently of the other phases. The area of each phase would be composed of smaller sub-units called "cells." Dikes would be constructed to form walls around each cell. Each cell would have a specific design (e.g., for a high or low marsh area). Channels would be constructed to connect the cells. The channels would serve several purposes: drainage from the cells, tidal circulation through the entire area, and migration of aquatic wildlife.

5.2 CATEGORIES OF DISPOSAL ALTERNATIVES

In addition to the No-Action Alternative, 12 alternatives were considered. These 12 alternatives are composed of different combinations of the eight disposal sites described in section 5.1. The quantities of sediment that would be disposed of at each site under each alternative are summarized in Table I-3. As shown in this table, the sum of the sediment quantities for all the sites under each alternative equals

5.8 mcy, which is the total volume of sediment to be dredged, down to -42 feet MLLW plus "overdepth," (i.e., to -43 feet). The following 9 assumptions were developed in formulating these disposal alternatives.

Dredging Assumptions

1. All volume estimates in Table 2.8-1 include dredging to project depth (i.e., -42 feet MLLW), plus a required 1 foot of overdepth in those channel and berth areas that contain "hard" material (i.e., Merritt sand and/or Old Bay mud), plus a 1 foot tolerance overdepth throughout the entire project area. The required 1 foot of overdepth dredging for those channel/berth areas with "hard" material is necessary to ensure a -42 foot project depth. The 1 foot of tolerance overdepth dredging is needed to address the inaccuracies of the dredging process.
2. The estimated total volume to be dredged, including overdepth, is 6.6 mcy.
3. Undisturbed Merritt sand formations are suitable for ocean disposal provided that the mitigation measures listed in section 4.2.6.2 are implemented.
4. In a worst-case analysis, up to 100,000 cy of dredged material may require disposal in a sanitary landfill. The RWQCB has determined that with adequate upland containment measures, no sediments will require landfill disposal (see RWQCB comment letter, Appendix M).

General Disposal Assumptions

5. Elevated chromium values alone did not disqualify sediments for either wetland cover or non-cover because of high natural background levels from geologic inputs into San Francisco Bay and the non-toxic effect of the chromium.

Site-Specific Disposal Assumptions

6. Capping at the Bay Farm Borrow Area with clean material would be done periodically, approximately once every 30 days.
7. Leonard Ranch is designed to serve as a regional dredged material rehandling facility for up to 30 years as previously studied by the LTMS.
8. Sediments considered for disposal at Sonoma Baylands include only material that is both acceptable for ocean disposal and acceptable for wetlands cover on the basis of bulk chemistry (excluding chromium).
9. Montezuma Wetlands would require 1 cy of cover material for each 1 cy of non-cover material.

Table I-3. Matrix of Disposal Alternatives¹

<i>Alternative</i>	<i>Ocean</i>	<i>Alcatraz</i>	<i>Borrow Area</i>	<i>Sonoma Baylands</i>	<i>Montezuma Wetlands</i>	<i>Galbraith</i>	<i>Leonard Ranch/ Redwood Landfill</i>	<i>Port/Landfill²</i>	<i>Total Volume</i>
A1. Maximum Ocean Disposal	5.4					1.2			6.6
A2. Maximum Ocean Disposal	5.4						1.2		6.6
B1. Maximum Wetland Restoration	0.1				3.2/3.2			0.1	6.6
B2. Maximum Wetland Restoration	2.9			2.5		1.2			6.6
B3. Maximum Wetland Restoration	2.9			2.5			1.2		6.6
C1. All Upland Disposal					3.2/3.2	0.2			6.6
C2. All Upland Disposal					3.2/3.2		0.2		6.6
D1. Maximum Confined Aquatic Disposal			4.8/1.8						6.6
E1. Maximum In-Bay Unconfined Aquatic Disposal	0.7	4.8				1.2			6.6
E2. Maximum In-Bay Unconfined Aquatic Disposal	0.7		4.8			1.2			6.6
E3. Maximum In-Bay Unconfined Aquatic Disposal	0.7	4.8					1.2		6.6
E4. Maximum In-Bay Unconfined Aquatic Disposal	0.7		4.8				1.2		6.6

- Notes**
- 1 All volumes are in million cubic yards. Where two numbers separated by a slash are noted, the first number is the volume suitable for cover material, and the second number is the volume that is unsuitable for cover.
 - 2 This option would be implemented only if required by the RWQCB; otherwise, this material would be disposed at Galbraith or Leonard Ranch.

5.2.1 Maximum Ocean Disposal

There are two alternatives that would maximize ocean disposal for material that is suitable for this option; the difference between the two is whether Galbraith or Leonard Ranch would be used for disposal of the material unsuitable for unconfined aquatic disposal.

5.2.2 Alternative A1 (Maximum Ocean Disposal with Galbraith)

Under this alternative, 5.4 mcy would be disposed at the ocean site, and 1.2 mcy would be disposed at Galbraith.

5.2.3 Alternative A2 (Maximum Ocean Disposal with Leonard Ranch)

Under this alternative, 5.4 mcy would be disposed at the ocean site, and 1.2 mcy would be disposed at Leonard Ranch.

5.2.4 Maximum Wetland Restoration

There are three alternatives that would maximize wetland restoration. The main difference among them is whether Sonoma Baylands, Galbraith, Leonard Ranch, or Montezuma Wetlands would be used.

5.2.5 Alternative B1 (Montezuma Wetlands Available)

Under this alternative, 0.1 mcy would be disposed at the ocean, 59,000 cy would be disposed at the Port/Landfill site, and 6.4 mcy would be disposed at Montezuma Wetlands. At Montezuma, 3.2 mcy of sediment would be suitable for cover material and 3.2 mcy would be unsuitable for cover material.

5.2.6 Alternative B2 (Galbraith Available)

Under this alternative, 2.9 mcy would be disposed at the ocean, 2.5 mcy would be disposed at Sonoma Baylands, and 1.2 mcy would be disposed at Galbraith.

5.2.7 Alternative B3 (Leonard Ranch Available)

Under this alternative, 2.9 mcy would be disposed at the ocean, 2.5 mcy would be disposed at Sonoma Baylands, and 1.2 mcy would be disposed at Leonard Ranch.

5.2.8 All Upland Disposal

Two alternatives would use only upland sites to dispose of the dredged sediment. The difference between the two is whether Galbraith or Leonard Ranch would be used.

5.2.9 Alternative C1 (Galbraith Available)

Under this alternative, 6.4 mcy would be disposed at Montezuma Wetlands, and 0.2 mcy would be disposed at Galbraith. At Montezuma, 3.2 mcy of sediment would be suitable for cover material and 3.2 mcy would be unsuitable for cover material.

5.2.10 Alternative C2 (Leonard Ranch Available)

Under this alternative, 6.4 mcy would be disposed at Montezuma Wetlands, and 0.2 mcy would be disposed at Leonard Ranch. At Montezuma, 3.2 mcy of sediment would be suitable for cover material and 3.2 mcy would be unsuitable for cover material.

5.2.11 Alternative D1 (Maximum Confined Aquatic Disposal)

Only one alternative would maximize the use of confined aquatic disposal. Under this alternative, 6.6 mcy would be disposed at Bay Farm Borrow Area (4.8 mcy cover material, 1.8 unsuitable for cover material).

5.2.12 Maximum Unconfined Aquatic Disposal

Four alternatives would maximize the use of unconfined aquatic disposal sites. The difference among the four is the amount of sediment that would be disposed at Alcatraz, Bay Farm, Galbraith, and Leonard Ranch.

5.2.13 Alternative E1 (Alcatraz and Galbraith)

Under this alternative, 0.7 mcy would be disposed at the ocean, 4.8 mcy would be disposed at Alcatraz, and 1.2 mcy would be disposed at Galbraith.

5.2.14 Alternative E2 (Borrow Area and Galbraith)

Under this alternative, 0.7 mcy would be disposed at the ocean, 4.8 mcy would be disposed at Bay Farm, and 1.2 mcy would be disposed at Galbraith.

5.2.15 Alternative E3 (Alcatraz and Leonard Ranch)

Under this alternative, 0.7 mcy would be disposed at the ocean, 4.8 mcy would be disposed at Alcatraz, and 1.2 mcy would be disposed at Leonard Ranch.

5.2.16 Alternative E4 (Borrow Area and Leonard Ranch)

Under this alternative, 0.7 mcy would be disposed at the ocean, 4.8 mcy would be disposed at Bay Farm, and 1.2 mcy would be disposed at Leonard Ranch.

5.2.17 No-Action Alternative

Under the No-Action Alternative, the proposed dredging of Oakland Harbor channels to -42 feet MLLW would not occur, and the Port would not be able to fully accommodate the deep-draft vessels. This alternative does not necessarily mean no change from current conditions for the potential dredged material disposal sites, as described in section 2.3 of the SEIR/S. For example, it is likely that use of some of the disposal sites (e.g., Sonoma Baylands and Montezuma Wetlands) would still eventually be used for dredged material even if the Oakland Harbor deepening project did not go forward.

5.3 Comparison of Alternatives

A detailed comparison of alternatives was prepared for the SEIR/S (section 6.2). The No-Action Alternative was rejected, because it does not meet project objectives. It was concluded (section 7.1) that the environmentally preferred alternative was Alternative B2, which includes use of the ocean disposal site, Sonoma Baylands, the Galbraith Golf Course, and the Port/Landfill option. Alternatives containing in-Bay disposal sites (e.g., Alcatraz and the Bay Farm Borrow Area) were eliminated because they violated Bay Conservation Development Commission policies on in-Bay disposal and, thus, were considered infeasible to implement. Additionally, management of the Alcatraz site by the Corps of Engineers gives preference to disposal of dredged material from the maintenance dredging of existing navigation channels. Given the large volume of material to be dredged for the deepening of the Oakland Harbor channels, disposal of this material at Alcatraz could jeopardize the ability of this site to accommodate the maintenance dredging disposal requirements of existing navigation channels.

Of the remaining alternatives, B2 had the fewest impacts on environmental resources and was one of the six alternatives that had substantial beneficial impacts on biological resources due to wetlands restoration at the Sonoma Baylands site.

Other factors justify the elimination of other disposal sites. For example, the Montezuma Wetlands site is well behind Sonoma Baylands in the environmental review and design process, and use of this site would be considerably more costly. Use of the Leonard Ranch site is not practicable given the Port's schedule, since preliminary studies only have been done and site design is still highly conceptual. Additionally, the site currently has no identified local sponsor for the federal project.

6.0 FAA FINDINGS

The FAA has reviewed the proposed project and has found that there will be no impact on existing or proposed FAA facilities or program responsibilities (Rodriquez 1994). Therefore, Section 4(f) of the Department of Transportation Act does not apply.

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APPENDIX J

Mitigation and Monitoring Requirements for the Selected Plan

APPENDIX J

MITIGATION AND MONITORING REQUIREMENTS FOR THE SELECTED PLAN

1.0 INTRODUCTION

This appendix includes the mitigation and monitoring requirements for the selected plan, Alternative B2, which would involve use of three disposal sites: the Ocean Section 102 site, Sonoma Baylands, and Galbraith Golf Course. This appendix is comprised of three parts:

Section 1.1	Mitigation Monitoring and Reporting Plan for the Selected Plan;
Section 1.2	Site Management and Monitoring Plan for the Ocean Section 102 site; and
Section 1.3	Mitigation for Potential Impacts on Herring Spawning in the Vicinity of the Dredging Activity in Oakland Harbor.

Section 1.1 addresses only significant impacts associated with the selected plan. Additional mitigation for the Ocean Section 102 site and the dredging site is presented in sections 1.2 and 1.3, respectively.

1.1 MITIGATION MONITORING AND REPORTING PLAN FOR THE SELECTED PLAN

Table J-1 presents the mitigation monitoring and reporting plan for the selected plan, Alternative B2.

1.2 SITE MANAGEMENT AND MONITORING PLAN FOR THE OCEAN SECTION 102 SITE

The EPA-proposed Site Management and Monitoring Plan (SMMP) for the Ocean Section 102 site (EPA 1993c) provides a basis for making site use management decisions using data collected in a tiered monitoring program. The plan was devised to avoid or mitigate adverse environmental impacts at and adjacent to the Ocean Section 102 site. The SMMP also lists several provisions for site use that have been incorporated into the disposal site use permit (in the MPRSA Section 103 process) that aim to: (1) restrict the inadvertent disposal of materials in transit to the Ocean Section 102 site, (2) define a target for material release, and (3) provide guidelines for monitoring compliance of these restrictions. The following EPA-proposed provisions, which would apply to the dredging contractor, are included in the proposed project:

Time of Disposal

- Barges will not leave the Bay when wave heights along the transit route are predicted to exceed 18 ft. Under other less severe weather conditions, extra precautions (such as reducing the load by 15 percent) will be taken to prevent spillage or other loss of material during transit to the site.

Disposal Technique

- No disposal barge shall be filled above its load limitation, and all loads must be certified by an inspector.

Table J-1
Mitigation Monitoring and Reporting Plan for the Selected Plan (Alternative B2)
(page 1 of 7)

Note: This table addresses the significant impacts of the selected plan, Alternative B2, which involves use of the Ocean Section 102 site, Sonoma Baylands, and Galbraith Golf Course. If no significant impact is expected for a given resource at one of these sites, that resource does not appear in the table.

Resource	Significant Impact	Mitigation Measure	Monitoring Action	Responsible Party	Timing
Ocean Section 102 Site					
Air Quality	Exceedance of AQMD NO _x emission threshold due to dredging and transport equipment.	Retard injection timing on all diesel-powered equipment and vessels.	Certification of all equipment prior to construction, then bi-annual spot monitoring.	Corps	By start of construction, then annual tune-up.
	Exceedance of AQMD SO ₂ and TOG emission thresholds due to dredging and transport equipment.	Implement reformulated fuel on all diesel-powered equipment and vessels based on the following approximate specifications: (1) cetane number of 48.6, (2) sulfur content of 0.05 percent by weight, (3) aromatics content of 34.7 percent, (4) olefins content of 2.1 percent, and (5) saturates content of 63.2 percent.	Identify fuel supply prior to construction, then maintain supply throughout construction. Spot monitoring for duration of construction.	Corps	During entire construction period.

Table J-1
Mitigation Monitoring and Reporting Plan for the Selected Plan (Alternative B2)
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Resource	Significant Impact	Mitigation Measure	Monitoring Action	Responsible Party	Timing
Sonoma Baylands					
Air Quality	Exceedance of AQMD NO _x emission threshold due to dredging and transport equipment.	Retard injection timing on all diesel-powered equipment and vessels.	Certification of all equipment prior to construction, then bi-annual spot monitoring.	Corps	By start of construction, then annual tune-up.
	Exceedance of AQMD SO ₂ and TOG emission thresholds due to dredging and transport equipment.	Implement reformulated fuel on all diesel-powered equipment and vessels as specified for the Ocean Section 102 site.	Identify fuel supply prior to construction, then maintain supply throughout construction. Spot monitoring for duration of construction.	Corps	During entire construction period.
	Fugitive dust emissions from exposed soil.	Apply water to exposed soil, as needed, to minimize dust emissions.	Designate personnel to monitor dust emissions during entire construction period.	Corps	During entire construction period.
Biological Resources	Disturbance associated with pipeline installation, levee breaching, and outlet channel scouring could cause nest abandonment by sensitive bird species.	Pre-construction surveys by qualified biologist to assess sensitive species nesting within 500 feet. Reschedule or relocate potentially disturbing activities during the nesting season (February through August) away from nesting areas. Limit pipeline placement to the existing berm southwest of the pipeline site.	Corps review and approve biologist's qualifications and survey results.	Corps	Survey during February-August nesting season and prior to initiation of construction and other activity on bayfront levees.

Table J-1
Mitigation Monitoring and Reporting Plan for the Selected Plan (Alternative B2)
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Resource	Significant Impact	Mitigation Measure	Monitoring Action	Responsible Party	Timing
Sonoma Baylands					
Biological Resources (cont.)	Noise caused by unloading and booster pump operations may disturb special-status wildlife.	Muffle and/or enclose pump to limit noise levels to less than 65 dBA at 50 feet from the pump.	Corps review pre-construction design; obtain noise measurements to verify mitigation effectiveness during operations.	Corps	Design review prior to construction; noise monitoring as necessary to verify compliance during operations.
	Disturbance of aquatic biota by pipeline construction and pumping operations; potential impacts from fuel spills or a break in the slurry pipeline.	Set anchors for the duration of the project; careful handling of fuel; install leak detection system on the pipe and/or monitor slurry discharge.	Corps review and approve contractor specifications; conduct periodic inspections.	Corps	Prior to commencement of, and during construction and operations.

Table J-1
Mitigation Monitoring and Reporting Plan for the Selected Plan (Alternative B2)
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Resource	Significant Impact	Mitigation Measure	Monitoring Action	Responsible Party	Timing
Galbraith Golf Course					
Air Quality	Exceedance of AQMD NO _x emission threshold due to dredging and transport equipment.	Retard injection timing on all diesel-powered equipment and vessels.	Certification of all equipment prior to construction, then bi-annual spot monitoring.	Corps	By start of construction, then annual tune-up.
	Exceedance of AQMD SO ₂ and TOG emission thresholds due to dredging and transport equipment.	Implement reformulated fuel on all diesel-powered equipment and vessels as specified for the Ocean Section 102 site.	Identify fuel supply prior to construction, then maintain supply throughout construction. Spot monitoring for duration of construction.	Corps	During entire construction period.
	Fugitive dust emissions from exposed soil.	Apply water to exposed soil, as needed, to minimize dust emissions.	Designate personnel to monitor dust emissions at the disposal site during entire construction period.	Corps/Port	During entire construction period.
	Fugitive dust emissions from truck transport of soil.	As needed, apply water and/or cover load with tarpaulins.	Designate personnel to monitor dust emissions from trucks during entire construction period.	Corps/Port	During entire construction period.

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Mitigation Monitoring and Reporting Plan for the Selected Plan (Alternative B2)
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Resource	Significant Impact	Mitigation Measure	Monitoring Action	Responsible Party	Timing
Galbraith Golf Course					
Hydrology	Significant impacts on groundwater quality could occur due to the lateral migration of existing leachate fluids containing petroleum products.	Design containment structures to meet RWQCB requirements.	Comply with permit conditions of the RWQCB.	Port	Before and during construction.
	Discharge of surface water may exceed water quality standards.	Monitor effluent. Place vegetative control areas outside of drying ponds to increase sedimentation and provide natural treatment for metals. If effluent exceeds RWQCB standards, hold decant water in ponds until standards met.	Comply with permit conditions of the RWQCB.	Port	Before and during construction, and during facility operations.
	Placement on site of sediments containing elevated levels of contaminants exceeding levels acceptable to the RWQCB.	Conduct additional sampling after the dredged material dries to confirm that there are no "hot spots" present.	Submit the results of analytical testing to the RWQCB. If the testing program shows that material within the drying facility exceeds applicable waste acceptance criteria, the Port will work with the RWQCB to establish a remediation program.	Port	At the end of the drying period, before construction of the golf course.

Table J-1
Mitigation Monitoring and Reporting Plan for the Selected Plan (Alternative B2)
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Resource	Significant Impact	Mitigation Measure	Monitoring Action	Responsible Party	Timing
Galbraith Golf Course					
Geology, Soils, & Seismicity	If a large magnitude earthquake occurred on a nearby fault, earthquake-induced levee failure at the Galbraith Site could cause geologic hazards on surrounding features such as Doolittle Drive, the interior drainage canal, and the San Leandro Wastewater Treatment Plant.	Design levees using standard geotechnical engineering practices to prevent catastrophic impacts on adjacent facilities in the event of failure.	Include requirements in contractors' specifications and monitor contractor compliance with specifications.	Port	During the design and construction phases.
Biological Resources	Loss of approximately 3.7 acres of seasonal freshwater marsh, tidal wetlands, and other waters of the United States (exact acreage to be determined by the Corps).	Design site to minimize wetland loss; provide compensatory on-site mitigation at a ratio of 1.1:1 to 1.3:1 on a per-acre basis.	Monitor compliance with Corps permit conditions.	Port	During the design and construction phases.
	Seasonal ponding may increase mosquitoes.	Consult with the Alameda County Mosquito Abatement District.	Alameda County Mosquito Abatement District will monitor site.	Port	During the design and construction phases.
	Disturbance of aquatic biota by pipeline construction and pumping operations; potential impacts from fuel spills or a break in the slurry pipeline.	Set anchors for the duration of the project; careful handling of fuel; install leak detection system on the pipe and/or monitor slurry discharge.	Corps review and approve contractor specifications; conduct periodic inspections.	Corps	Prior to commencement of construction and operations.
	Potential impacts on burrowing owls if present, a species of special concern.	If active burrows are identified during a pre-construction survey, owls and burrows will be relocated off site.	Monitor contractor compliance.	Port	Prior to commencement of construction.

Table J-1
Mitigation Monitoring and Reporting Plan for the Selected Plan (Alternative B2)
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Resource	Significant Impact	Mitigation Measure	Monitoring Action	Responsible Party	Timing
Galbraith Golf Course					
Noise	The unloader and booster pumps could cause excessive noise, depending on their placement.	Locate or muffle pumps so that noise does not exceed 60 dBA between 7 A.M. and 10 P.M. and 50 dBA between 10 P.M. and 7 A.M.	The construction contract shall specify appropriate pump locations or mufflers.	Corps	During construction.
Land Use	Loss of golfing recreational uses during the 7-year interim construction phase at the Galbraith Golf Course.	Allow for continuance of youth golfing program. Subsidize senior golf club, and Oakland senior use of nearby golf course.	Mitigation measures will be specified in lease agreement between the Port and the City of Oakland for use of Galbraith site.	Port/City of Oakland	During entire period when golf course would be unavailable for use.
		Provide new golf course.	Mitigation measures will be specified in lease agreement between the Port and the City of Oakland for use of Galbraith site.	Port	At the end of the dredged sediment drying phase.
	Loss of municipal soccer field on Galbraith Golf Course site.	The City of Oakland will construct a new soccer field at the Curt Flood Sports Complex in East Oakland.	Mitigation measures will be specified in lease agreement between the Port and the City of Oakland for use of Galbraith site.	City of Oakland	Within one year from onset of construction.

Mitigation and Monitoring Requirements for the Selected Plan

- Barges with a capacity of 3,000 cubic yards will be loaded to 80 percent capacity (2,400 cubic yards) for each tug boat captain's initial 12 trips to the Section 102 site. After each captain has completed the initial 12 trips, subsequent barge loads may be filled to the load limitation, as permitted by sea conditions.
- No water or dredged material is permitted to leak or spill from the barges during transit to the Section 102 site.
- A tow speed of less than or equal to 6 knots will be used.
- Tugs with barges will remain outside of the territorial sea boundary surrounding the Farallon Islands by following the inner portion of the outbound western shipping lane for transit into and out of the Bay.
- When the disposal barge is west of the Vessel Separation Scheme (VSS), the tug shall proceed directly to the Section 102 site. The barges must be towed in transit routes that pass at least 3 nautical miles from the Farallon Islands.
- The U.S. Coast Guard's (USCG) Offshore Vessel Movement Reporting System (OVMRS), which extends 38 miles offshore Mount Tamalpais, will be used to track barges within its range.
- The tug is required to use an electronic positioning system (i.e., a miniranger system with at least two transponders or a Global Positioning System (GPS) with a minimum accuracy and precision of 100 ft (30 meters) for disposal operations. If the positioning system fails, all disposal operations shall cease until the navigational capabilities are restored.

Placement of Materials

- All material will be discharged within a 1.1-nautical-mile diameter circle centered at 37°39'N, 123°29'W.
- When dredged material is discharged, no portion of the barge shall be further than 3,200 feet from the center of the Ocean Section 102 site.

Disposal Monitoring and Documentation

- The permittee will maintain daily records of dredging operations, transportation schedules, barge load volumes disposed, and exact location and time of disposal.
- The tug captain will maintain a copy of all weather reports and will make wind and sea observations.
- Each tug will maintain a computer printout from GPS or other acceptable navigation system showing transit routes and disposal coordinates, including the time and position of the disposal barge when the barge doors open and close.

Mitigation and Monitoring Requirements for the Selected Plan

- A Contractor Quality Control (CQC) inspector will observe all dredging operations and submit reports containing a description of operations for each barge load, a checklist, a transit route map, a printout of coordinates from each waypoint and release point, a record of radio transmission and facsimile from the tug captain on a weekly basis.
- A permittee will report any violations to EPA and to COE within 24 hours. In the event of a violation, the permittee must make all necessary changes to bring disposal operations into compliance before making another trip to the Section 102 site.
- Development and implementation of more sophisticated surveillance systems, which can be demonstrated to EPA to be effective and capable of being audited, may be substituted pending approval from EPA for one or more of the above conditions.

Evaluations and possible revisions of these generic site-use conditions will occur as needed depending on the results from the monitoring program. Additional conditions on use of the Section 102 site may be determined during the permit review process.

Following dredged material placement, a tiered monitoring approach will be used to address the effects of dredged material on the marine environment. The Physical Monitoring Plan is focused on the potential transport of dredged material from the site. Numerical modeling will predict the extent of the dredged material deposit followed by field verification sampling. Sediment quality is assessed by measuring contaminant levels on and off site. If unacceptable adverse impacts are detected, several management actions could be utilized, including reducing the size or location of the disposal zone, revising permit conditions on placement, and limiting the amounts of material disposed in a year. EPA anticipates finalizing the proposed SMMP in July 1994. The requirements of the final SMMP will be incorporated as a part of the construction of the Oakland Harbor project.

1.3 MITIGATION FOR POTENTIAL IMPACTS ON HERRING SPAWNING IN THE VICINITY OF THE DREDGING ACTIVITY IN OAKLAND HARBOR

The source of the following information is a Department of Fish and Game letter dated May 26, 1994, to the Corps of Engineers San Francisco District, on the issue of dredging during Pacific herring spawning periods.

Because of potential adverse impacts to eggs and early larval forms of Pacific herring from suspended dredged material in the water column, the California Department of Fish and Game (DFG) routinely recommends that all dredging projects that are proposed for areas in which Pacific herring have historically spawned be suspended during the period of peak spawning activity (December 1 to March 1). The DFG, on occasion, has permitted some projects to continue dredging into the month of December when necessary provided that two conditions are met: (1) a qualified herring observer is on site during all dredging operations, and (2) dredging is avoided for approximately 2 weeks following observation and documentation of a herring spawn within 200 meters of the dredging site.

The DFG acknowledges that the overall design of the proposed project includes minimal impacts to fish and wildlife, and provides substantial resource habitat benefits through the creation of 289 acres of tidal marsh at Sonoma Baylands. The Department also acknowledges that, in order to maximize these benefits through efficient timing of project construction, it will be necessary to conduct dredging operations on

Mitigation and Monitoring Requirements for the Selected Plan

a continuous 24-month schedule. Considering these unique circumstances, the DFG has accepted the Corps' request for a waiver of the Department's normal recommendation that dredging cease during the herring spawning period. The DFG grants this waiver provided that the Corps and Port of Oakland commit to abiding by the conditions for December dredging as previously outlined in the DFG letter to Mr. Calvin Fong, dated September 22, 1993. The DFG will evaluate the project prior to completion based on how successful these conditions are during the 1994-95 herring spawning season.

Mitigation and Monitoring Requirements for the Selected Plan

APPENDIX K

Sediment Characterization for Wetland and Upland Disposal

Table K-1. Summary of Testing Methods
Port of Oakland 42-Foot Project Sediments

Environmental Pathway Evaluated/Test Name	Sample Location	Parameters	Preparation Methods	Extraction Methods	Analysis Methods
SEDIMENT QUALITY					
Bulk Chemistry Word et al, 1988 Word et al, 1990a,b,c Kohn et al, 1992a Kohn et al, 1992b Pinza et al, 1993	Inner/Outer Harbor; Berthing Areas; Turning Basin Wings	Grain Size	NA	NA	Sieve and pipet (PSEP, 1986)
		TOC	ball milling	Inorganic carbon acidification	CO2 combustion (PSEP, 1986; SW-846 9060)
		TVS	ball milling	NA	Combustion (PSEP, 1986)
		TOG	NA	Freon extraction	Infrared spec (EPA 413.2)
		TPH	silica gel cleanup	Freon extraction	Infrared spec (EPA 418.1)
		PAHs	NA	MeCl w/soxhlet/sonication	GC/MS SIM (SW-846 8270)
		Pesticides/PCBs	NA	MeCl w/soxhlet/sonication; alumina GPC cleanup	GC/ECD (SW-846 8080)
		As,Cr,Cu,Ni,Pb,Zn	SPEX mixing/ball milling	NA	XRF (Sanders, 1987)
		Ag,Cd,Se	SPEX mixing/ball milling	Acid digestion	GFAA (SW-846 7000; Bloom & Crecelius, 1984)
		Hg	SPEX mixing/ball milling	Acid digestion	CVAA (SW-846 7471; Bloom & Crecelius, 1984)
		Butyltins	NA	MeCl/tropolone;florisil lc cleanup	GC/FPD (Unger, 1986)
Bulk Chemistry Lee et al, 1993	(Inner: 1 composite from I-C1 to I-C18) (Outer: 1 composite from O-C1 to O-C13)	Ag,As,Cd,Cr,Cu,Hg,Ni, Pb,Se,Zn Butyltins PAHs Pesticides/PCBs	Same as Lee et al, 1992	Same as Lee et al, 1992	Same as Lee et al, 1992

Table K-1. Summary of Testing Methods
Port of Oakland 42-Foot Project Sediments

Environmental Pathway Evaluated/Test Name	Sample Location	Parameters	Preparation Methods	Extraction Methods	Analysis Methods
Bulk Chemistry Lee et al, 1992	(Turning Basin Wings: 2 composites, upper and lower, from SS-1 to SS-4; SS-6 to SS-10; TS-1 to TS-7)	As,Cr,Cu,Ni,Pb,Zn Ag,Cd,Sb Hg Butyltins SOCs (PAHs) Pesticides/PCBs VOCs	Mixed, freeze dried, ground	Hot NO3, perchloric, HF acid digestion Hot NO3, perchloric, HF acid digestion MeCl, tropolone, sodium sulfate Solvent extraction, column cleanup	XRF (Nielson and Sanders, 1983) GFAA CVAA GC-FPD (Unger et al., 1986) EPA Method 625 GC-ECD SW-846 8080 GC/MS EPA Method 624
Bulk Chemistry HLA, 1989	Turning Basin Wings: 4 composites	Metals Butyltins VOCs SOCs TPH	EPA SW-846 Methods	EPA SW-846 Methods	SW-846 6000/7000 series Moss Landing Lab Method SW-846 8240 SW-846 8270 SW-846 5030/8015; 3550/8015
Bulk Chemistry WCC, 1988	Turning Basin Wings: 3 composites	Metals VOCs, SOCs, Pest/PCBs TPH gas/diesel Petroleum hydrocarbons	Not reported	Not reported Freon	Not reported SW-846 8240,8270,8080 SW-846 5030/8015; 3550/8015 Gravimetric Not reported

Table K-1. Summary of Testing Methods
Port of Oakland 42-Foot Project Sediments

Environmental Pathway Evaluated/Test Name	Sample Location	Parameters	Preparation Methods	Extraction Methods	Analysis Methods
LEACHATE					
Kinetic Batch Lee et al, 1993	(Inner: 3 composites from I-C1 to I-C18) (Outer: 3 composites from O-C1 to O-C13)	Ag,As,Cd,Cr,Cu,Hg, Ni,Pb,Se,Zn Butyltins PAHs Pesticides/PCBs	See Table K-2	See Table K-2	Same as Lee et al, 1992
Kinetic Batch Lee et al, 1992	(Turning Basin Wings: 2 composites from SS-1 to SS-4; SS-6 to SS-10; TS-1 to TS-7)	As,Cd,Cr,Cu,Hg,Zn Butyltins	See Table K-2	See Table K-2	GFAA CVAA GC-FPD (Unger et al, 1986)
Sequential Batch Lee et al, 1993	(Inner: 3 composites from I-C1 to I-C18) (Outer: 3 composites from O-C1 to O-C13)	Ag,As,Cd,Cr,Cu,Hg, Ni,Pb,Se,Zn Butyltins PAHs Pesticides/PCBs	See Table K-2	See Table K-2	Same as Lee et al, 1992
Sequential Batch Lee et al, 1992	(Turning Basin Wings: 2 composites from SS-1 to SS-4; SS-6 to SS-10; TS-1 to TS-7)	As,Cd,Cr,Cu,Hg,Zn Butyltins pH Conductivity	See Table K-2	See Table K-2	GFAA CVAA GC-FPD (Unger et al, 1986)
Column Test Lee et al, 1993	(Inner: 3 composites from I-C1 to I-C18) (Outer: 3 composites from O-C1 to O-C13)	Ag,As,Cd,Cr,Cu,Hg, Ni,Pb,Se,Zn Butyltins PAHs Pesticides/PCBs	See Table K-2	See Table K-2	Same as Lee et al, 1992
Interstitial Water Lee et al, 1992	(Turning Basin Wings: 2 composites from SS-1 to SS-4; SS-6 to SS-10; TS-1 to TS-7)	As,Cd,Cr,Cu,Hg,Zn Butyltins	See Table K-2	See Table K-2	Not reported
Pore Water HLA, 1989	Turning Basin Wings: 3 composites	Metals, VOCs, THM Butyltin, Cr,Cl,F Petroleum hydrocarbons Nitrate/nitrite, sulfate	See Table K-2	See Table K-2	SW-846 methods

Table K-1. Summary of Testing Methods
Port of Oakland 42-Foot Project Sediments

Environmental Pathway Evaluated/Test Name	Sample Location	Parameters	Preparation Methods	Extraction Methods	Analysis Methods
Simulated Rainwater Extraction HLA, 1989	Turning Basin Wings: 4 composites	Metals Butyltin Alkalinity, Br,Cl,CN,F Nitrate/nitrite, sulfate Sulfides, TDS, pH Pesticides/PCBs SOCs, oil and grease, TOC	See Table K-2	See Table K-2	SW-846 methods
SURFACE RUNOFF					
Rainfall Simulator/Lysimeter Lee et al, 1993	(Inner: 1 composite) (Outer: 1 composite)	Ag,As,Cd,Cr,Cu,Hg,Pb,Zn Butyltins TSS, pH, EC	See Table K-2	See Table K-2	Same as Lee et al, 1992
Rainfall Simulator/Surface Runoff Lee et al, 1992	(Turning Basin Wings: 2 composites)	Ag,As,Cd,Cr,Cu,Hg,Pb,Zn Butyltins TSS, pH, EC	See Table K-2	See Table K-2	Same as Lee et al, 1992
EFFLUENT, SHORT TERM					
Modified Elutriate Lee et al, 1993	(Inner: 1 composite) (Outer: 1 composite)	Ag,As,Cd,Cr,Cu,Hg, Ni,Pb,Se,Zn Butyltins PAHs pH, DO, salinity	See Table K-2	See Table K-2	Same as Lee et al, 1992
Modified Elutriate Lee et al, 1992	(Turning Basin Wings: 2 composites)	As,Cd,Cr,Cu,Hg,Pb,Zn Butyltins Tot. P, ortho PO ₄ , nitrate Ammonia, TOC, conductivity pH, DO, salinity	See Table K-2	See Table K-2	GFAA CVAA GC-FPD (Unger et al, 1986) Not reported

Table K-1. Summary of Testing Methods
Port of Oakland 42-Foot Project Sediments

Environmental Pathway Evaluated/Test Name	Sample Location	Parameters	Preparation Methods	Extraction Methods	Analysis Methods
LANDFILL LEACHATE/HAZARDOUS WASTE CHARACTERIZATION					
WET & TCLP COE and Battelle, 1993	(Inner: 1 composite)	Ammonia	Not reported	WET	EPA 350.3
		Nitrate		WET	EPA 353.2
		Cyanide		WET	EPA 9010
		Sulfide		WET	EPA 9030
		Chromium 6 +		WET	EPA 7196
		pH		WET	EPA 9045
		Metals		WET	EPA 6010,7060,7740,7421, 7470,7761,7131,7191
		Organic lead		WET	ASTM 3237-79 modified
		Pesticides/PCBs		TCLP	SW-846 8080
		TPH gasoline		TCLP	SW-846 5030/8015 modified
		TPH diesel, motor oil		TCLP	GC-FID SW-846 8015 modified
		VOCs		TCLP	SW-846 8240
		SOCs		TCLP	SW-846 8270
WET Battelle, 1993c	Inner: 5 samples Outer: 1 sample	TTLC and STLC metals	WET 3050	WET	EPA 6010, 7196, 7471, 7060, 7470, 7740
WET Battelle, 1993b	Turning Basin Wings: 2 samples	TTLC and STLC metals	WET 3050	WET	EPA 6010, 7470, 7471, 7740, 7196

Table K-1. Summary of Testing Methods
Port of Oakland 42-Foot Project Sediments

Environmental Pathway Evaluated/Test Name	Sample Location	Parameters	Preparation Methods	Extraction Methods	Analysis Methods
WET HLA, 1989	Turning Basin Wings: 4 composites	Metals, pH, pesticides VOCs, SOCs	WET	WET	EPA Methods
WET WCC, 1988	Turning Basin Wings: 3 composites	Metals	WET	WET	Not reported

Notes:

NA = not applicable; n = number of samples; lc = liquid chromatography

TOC = total organic carbon; TVS = total volatile sulfides; TOG = total oil and grease; TPH = total petroleum hydrocarbons; PAH = polynuclear aromatic hydrocarbons; PCB = polychlorinated biphenyls;

MeCl = methylene chloride; GPC = gel permeation chromatography; GC = gas chromatography; MS = mass spectrometry; SIM = selective ion monitoring; ECD = electron capture detector;

XRF = x-ray florescence; GFAA = graphite furnace atomic absorption; CVAA = cold vapor atomic absorption; FPD = flame photoionization detector; TSS = total suspended solids

Table K-2. Comparison of Leaching/Surface Runoff/Effluent Test Protocols
Port of Oakland 42-Foot Project Sediments

Test Name	Sample Preparation	Fluid Composition	Test Vessel	Method of Contact
Waste Extraction Test	milling to <2mm 0.45 um filtration	0.2M sodium citrate pH = 5.0 for Cr +6, DI water	polyethylene or glass container	table shaker, over head stirrer, or rotary extractor
Kinetic Batch	WES, 1993; anaerobic with nitrogen atmosphere WES, 1992; anaerobic/aerobic	DDI	multiple centrifuge tubes metals: polycarb., 250 ml org.: stain. steel, 450 ml	metals: reciprocating shaker @ 160 cpm org: rotary mixer @ 40 rpm
Sequential Batch	aerobic: 6mo drying anaerobic: nitrogen atmosphere	DDI	multiple centrifuge tubes metals: polycarb., 250 ml org.: stain. steel, 450 ml	metals: reciprocating shaker @ 160 cpm org: rotary mixer @ 40 rpm
Column Leach	manual vibration for loading of column	DDI	column: 25.4 cm dia. 4 cm depth	column; pumped leachate in upflow mode
Rainfall Simulator/ Lysimeter System	thorough mixing; decant standing water wet and dry tests (dried for 6 months)	ns	4.57m X 1.22m aluminum lysimeter bed	rotating disk-type rainfall simulator
Modified Elutriate*	ns	ns	glass columns	column setting
Simulated Rainwater Extraction	mixed	DI with bubbled CO2 to pH = ~4	polyethylene or glass container	table shaker, over head stirrer, or rotary extractor
Pore Water	mixed	na	5 gal plastic bucket	gravity drain
Interstitial Water	nitrogen atmosphere	na	metals: 250ml polycarbon TBT: 450ml stain. steel	centrifuge

**Table K-2. Comparison of Leaching/Surface Runoff/Effluent Test Protocols
Port of Oakland 42-Foot Project Sediments**

Test Name	Extraction Frequency	Sample Mass/ Liquid:Solid	Test Duration	Leachate Separation
Waste Extraction Test	at 48 hours	50 g/ 10 to 1	48 hours	0.45um filtration with centrifuge, if necessary metals: acidify
Kinetic Batch	Lee et al, 1993 TBT/PAH: 1,2,7 d metals: .25,1,2,3,7,10 d Lee et al, 1992: TBT: 1,2 d metals: .25,1,2,3,4,5,10,14 d	200 g/ 4 to 1	Lee et al, 1993: metals up to 10 d; organics up to 7 d Lee et al, 1992: metals up to 14 d; TBT up to 2 d	centrifuge; metals: .45 um filter org.: 0.1 filter acidify metals/PAH
Sequential Batch	Analyze leachate and replace for each leach cycle	200 g/ 4 to 1	24 hours/leach cycle metals: 7 leach cycles butyltin/PAH: 6 leach cycles	centrifuge; metals: .45 um filter org.: 0.1 filter acidify metals/PAH
Column Leach	na	varies; depending on material loaded/ **	> 10 pore volumes eluted***	sample bottle at outflow; metals acidified to pH <2
Surface Runoff	na	vol. = 1.84 cu meters rainfall = 5.08 cm/hr	3 30-min storm events	sample collected at 5, 15, and 25 min after runoff began; filtered and unfiltered
Modified Elutriate	ns	ns	ns	ns
Simulated Rainwater Extraction	at 48 hours	50 g 10 to 1	48 hours	0.45um filtration with centrifuge, if necessary metals: acidify
Pore Water	once	5 gallons	na	gravity separation; filtration
Interstitial Water	once	na	na	centrifuge; metals: .45 um filter org.: 0.1 filter acidify metals

Notes:

DDI = Deoxygenated distilled deionized water; TBT = tributyltin; PAH = polynuclear aromatic hydrocarbons

ns = not specified; na = not applicable

* = No test protocols specified; see Palermo, 1985 for general description of modified elutriate test protocols.

** = For Oakland Inner Harbor composites, n = 0.47, SG = 2.73, w = 0.323, v = 1.2E10-5 to 2.8E10-5; Dp = 4.8E10-7 to 6.0E10-7

For Oakland Outer Harbor composites, n = 0.77, SG = 2.76, w = 1.187, v = 1.2E10-5 to 9.5E10-6; Dp = 1.1E10-7 to 1.3E10-7

where n = porosity; SG = specific gravity; w = water content; v = average pore water velocity, cm/sec; DP = dispersion coefficient, cm2/sec

*** = for a 15 foot lift, at K = 1E10-6 cm/sec and n = 0.6, one pore volume is about nine years of leaching

Table K-3. Statistical Data Summary of Chemical Analysis for Sediment Samples
Galbraith Disposal Group
Port of Oakland 42-Foot Project Sediments

Parameter	Units	Number of Detects/Analyses	Minimum Detected Value	Maximum Detected Value	Arithmetic Mean	Volume Weighted Concentrations
<u>VOCs</u>						
Benzene	ug/kg	0 / 3	--	--	--	--
Bromodichloromethane	ug/kg	0 / 3	--	--	--	--
Bromoform	ug/kg	0 / 3	--	--	--	--
Bromomethane	ug/kg	0 / 3	--	--	--	--
Carbon tetrachloride	ug/kg	0 / 3	--	--	--	--
Chlorobenzene	ug/kg	0 / 3	--	--	--	--
2-Chloroethyl vinyl ether	ug/kg	0 / 3	--	--	--	--
Chloroform	ug/kg	0 / 3	--	--	--	--
Chloromethane	ug/kg	0 / 3	--	--	--	--
Dibromochloromethane	ug/kg	0 / 3	--	--	--	--
1,2-Dichlorobenzene	ug/kg	0 / 3	--	--	--	--
1,3-Dichlorobenzene	ug/kg	0 / 3	--	--	--	--
1,4-Dichlorobenzene	ug/kg	0 / 3	--	--	--	--
1,1-Dichloroethane	ug/kg	0 / 3	--	--	--	--
1,2-Dichloroethane	ug/kg	0 / 3	--	--	--	--
1,1-Dichloroethene	ug/kg	0 / 3	--	--	--	--
trans-1,2-Dichloroethene	ug/kg	0 / 3	--	--	--	--
1,2-Dichloropropane	ug/kg	0 / 3	--	--	--	--
1,3-Dichloropropane	ug/kg	0 / 3	--	--	--	--
Ethyl benzene	ug/kg	0 / 3	--	--	--	--
Methylene chloride	ug/kg	0 / 3	--	--	--	--
1,1,2,2-Tetreachloroethane	ug/kg	0 / 3	--	--	--	--
Tetrachloroethene	ug/kg	0 / 3	--	--	--	--
Toluene	ug/kg	0 / 3	--	--	--	--
1,1,1-Trichloroethane	ug/kg	0 / 3	--	--	--	--
1,1,2-Trichloroethane	ug/kg	0 / 3	--	--	--	--
Trichloroethene	ug/kg	0 / 3	--	--	--	--
Vinyl chloride	ug/kg	0 / 3	--	--	--	--

Table K-3. Statistical Data Summary of Chemical Analysis for Sediment Samples
Galbraith Disposal Group
Port of Oakland 42-Foot Project Sediments

Parameter	Units	Number of Detects/Analyses	Minimum Detected Value	Maximum Detected Value	Arithmetic Mean	Volume Weighted Concentrations
<u>SOCs</u>						
Acenaphthylene	ug/kg	26 / 50	1.00	152.69	27.69	17.13
Acenaphthene	ug/kg	29 / 50	1.00	114.50	27.36	15.17
Anthracene	ug/kg	40 / 60	0.44	500.00	76.19	47.55
Benzidine	ug/kg	0 / 3	--	--	--	--
Benzo(a)anthracene	ug/kg	47 / 60	0.74	1,150.89	176.35	111.12
Benzo(a)pyrene	ug/kg	46 / 59	0.46	2,515.56	314.94	226.31
Benzo(b&k)fluoranthene	ug/kg	18 / 19	13.34	2,800.00	903.48	278.82
Benzo(b)fluoranthene	ug/kg	27 / 37	0.52	3,812.58	313.97	394.14
Benzo(b,k,j)fluoranthene	ug/kg	2 / 2	546.07	777.87	661.97	661.97
Benzo(g,h,i)perylene	ug/kg	40 / 59	2.00	1,599.66	189.56	179.80
Benzo(k)fluoranthene	ug/kg	27 / 39	0.28	1,346.45	141.52	146.99
4-Bromophenylphenylether	ug/kg	0 / 3	--	--	--	--
Butylbenzylphthalate	ug/kg	6 / 12	65.00	990.00	216.60	179.74
Bis(2-chloroethoxy)methane	ug/kg	0 / 3	--	--	--	--
Bis(2-chloroethyl)ether	ug/kg	0 / 3	--	--	--	--
Bis(2-chloroisopropyl)ether	ug/kg	0 / 3	--	--	--	--
4-Chloro-3-methylphenol	ug/kg	0 / 3	--	--	--	--
2-Chloronaphthalene	ug/kg	0 / 3	--	--	--	--
2-Chlorophenol	ug/kg	0 / 3	--	--	--	--
4-Chlorophenyl phenylether	ug/kg	0 / 3	--	--	--	--
Chrysene	ug/kg	48 / 58	0.61	1,700.00	247.07	154.29
Di-n-butylphthalate	ug/kg	4 / 14	27.00	340.00	114.86	109.75
Di-n-octylphthalate	ug/kg	1 / 12	310.00	310.00	121.14	157.27
Dibenzo(a,h)anthracene	ug/kg	29 / 59	0.26	627.89	54.86	36.58
3,3'-Dichlorobenzidine	ug/kg	0 / 3	--	--	--	--
2,4-Dichlorophenol	ug/kg	0 / 3	--	--	--	--
Diethyl phthalate	ug/kg	0 / 3	--	--	--	--
Dimethyl phthalate	ug/kg	0 / 3	--	--	--	--
2,4-Dimethylphenol	ug/kg	0 / 3	--	--	--	--
4,6-Dinitro-2-methylphenol	ug/kg	0 / 3	--	--	--	--
2,4-Dinitrophenol	ug/kg	0 / 3	--	--	--	--
2,4-Dinitrotoluene	ug/kg	0 / 3	--	--	--	--
2,6-Dinitrotoluene	ug/kg	0 / 3	--	--	--	--
1,2-Diphenylhydrazine	ug/kg	0 / 3	--	--	--	--
Bis(2-ethylhexyl)phthalate	ug/kg	11 / 14	22.00	3,900.00	738.50	592.97
Fluoranthene	ug/kg	50 / 61	0.78	2,000.00	339.90	224.46
Fluorene	ug/kg	27 / 59	0.26	120.00	32.44	16.85
Hexachlorobenzene	ug/kg	0 / 3	--	--	--	--
Hexachlorobutadiene	ug/kg	0 / 3	--	--	--	--
Hexachlorocyclopentadiene	ug/kg	0 / 3	--	--	--	--
Hexachloroethane	ug/kg	0 / 3	--	--	--	--
Indeno(1,2,3-cd)pyrene	ug/kg					
Isophorone	ug/kg					
Naphthalene						

Table K-3. Statistical Data Summary of Chemical Analysis for Sediment Samples
Galbraith Disposal Group
Port of Oakland 42-Foot Project Sediments

Parameter	Units	Number of Detects/Analyses	Minimum Detected Value	Maximum Detected Value	Arithmetic Mean	Volume Weighted Concentrations
<u>SOCs (continued)</u>						
Hexachlorocyclopentadiene	ug/kg	0 / 3	--	--	--	--
Hexachloroethane	ug/kg	0 / 3	--	--	--	--
Indeno(1,2,3-cd)pyrene	ug/kg	41 / 59	2.44	1,774.19	258.71	180.12
Isophorone	ug/kg	0 / 3	--	--	--	--
Naphthalene	ug/kg	43 / 50	0.53	121.00	34.53	23.58
Nitrobenzene	ug/kg	0 / 3	--	--	--	--
2-Nitrophenol	ug/kg	0 / 3	--	--	--	--
4-Nitrophenol	ug/kg	0 / 3	--	--	--	--
n-Nitrosodimethylamine	ug/kg	0 / 3	--	--	--	--
n-Nitrosodiphenylamine	ug/kg	0 / 3	--	--	--	--
n-Nitrosodiprophylamine	ug/kg	0 / 3	--	--	--	--
PAHs total high mole. wt	mg/kg	7 / 7	5.27	29.13	15.30	20.18
PAHs total low mole. wt	mg/kg	7 / 7	0.25	2.86	1.04	1.44
Pentachlorophenol	ug/kg	0 / 3	--	--	--	--
Phenanthrene	ug/kg	48 / 60	0.58	879.11	155.16	100.78
Phenol	ug/kg	0 / 3	--	--	--	--
Phthalates (total)	ug/kg	6 / 6	0.38	1.91	1.07	1.16
Pyrene	ug/kg	50 / 61	1.09	3,400.00	604.04	419.99
1,2,4-Trichlorobenzene	ug/kg	0 / 3	--	--	--	--
2,4,6-Trichlorophenol	ug/kg	0 / 3	--	--	--	--
<u>PESTICIDES</u>						
Aldrin	ug/kg	0 / 44	--	--	--	--
alpha-BHC	ug/kg	18 / 50	0.28	1.03	1.49	1.44
beta-BHC	ug/kg	4 / 44	0.15	5.20	1.50	1.59
delta-BHC	ug/kg	3 / 45	0.18	1.40	1.55	1.61
gamma-BHC	ug/kg	1 / 44	0.54	0.54	1.05	1.30
Chlordane	ug/kg	0 / 31	--	--	--	--
alpha-Chlordane	ug/kg	0 / 12	--	--	--	--
gamma-Chlordane	ug/kg	0 / 12	--	--	--	--
4,4'-DDD	ug/kg	15 / 50	0.48	12.20	2.62	2.61
4,4'-DDE	ug/kg	16 / 59	0.30	26.84	2.97	2.85
4,4'-DDT	ug/kg	8 / 50	0.21	3.00	1.83	1.87
Dieldrin	ug/kg	5 / 50	0.19	14.97	1.64	2.09
Endosulfan I	ug/kg	3 / 51	0.16	13.00	1.99	1.57
Endosulfan II	ug/kg	4 / 45	0.14	25.00	2.50	1.94
Endosulfan sulfate	ug/kg	2 / 44	0.22	0.62	2.45	2.47
Endrin	ug/kg	0 / 50	--	--	--	--
Endrin aldehyde	ug/kg	0 / 40	--	--	--	--
Endrin ketone	ug/kg	0 / 10	--	--	--	--
Heptachlor	ug/kg	2 / 50	2.69	3.81	1.02	1.34
Heptachlor epoxide	ug/kg	2 / 51	1.83	2.16	1.43	1.40
Methoxychlor	ug/kg	0 / 15	--	--	--	--
Toxaphene	ug/kg	0 / 43	--	--	--	--

Table K-3. Statistical Data Summary of Chemical Analysis for Sediment Samples
Galbraith Disposal Group
Port of Oakland 42-Foot Project Sediments

Parameter	Units	Number of Detects/Analyses	Minimum Detected Value	Maximum Detected Value	Arithmetic Mean	Volume Weighted Concentrations
<u>PCBs</u>						
Aroclor - 1016	ug/kg	0 / 17	--	--	--	--
Aroclor - 1016/1242	ug/kg	0 / 11	--	--	--	--
Aroclor - 1221	ug/kg	0 / 17	--	--	--	--
Aroclor - 1232	ug/kg	0 / 17	--	--	--	--
Aroclor - 1242	ug/kg	3 / 58	150.00	220.00	23.93	13.91
Aroclor - 1248	ug/kg	6 / 50	64.69	325.26	30.06	24.65
Aroclor - 1254	ug/kg	27 / 61	17.00	745.20	88.35	68.13
Aroclor - 1260	ug/kg	17 / 61	10.00	354.89	42.01	31.92
<u>TPH</u>						
Oil & grease	mg/kg	48 / 61	3.15	2,004.00	209.38	134.43
TPH	mg/kg	42 / 57	1.04	2,082.00	144.87	90.76
TPH hi B.P.	mg/kg	0 / 3	--	--	--	--
TPH low B.P.	mg/kg	0 / 3	--	--	--	--
<u>METALS</u>						
Aluminum	mg/kg	2 / 2	18,000.00	18,100.00	18,050.00	18,070.27
Antimony	mg/kg	16 / 21	1.20	18.83	4.53	7.72
Arsenic	mg/kg	69 / 69	1.86	28.91	8.71	7.35
Barium	mg/kg	5 / 5	6.74	104.00	66.92	66.01
Beryllium	mg/kg	4 / 5	0.30	0.65	0.38	0.33
Cadmium	mg/kg	66 / 69	0.02	8.04	0.77	0.45
Chromium	mg/kg	66 / 66	106.33	930.00	359.99	404.65
Chromium III	mg/kg	3 / 3	69.57	110.87	87.68	82.74
Chromium VI	mg/kg	0 / 3	--	--	--	--
Cobalt	mg/kg	5 / 5	7.17	13.73	10.14	9.14
Copper	mg/kg	69 / 69	9.10	423.00	70.09	56.46
Cyanide	mg/kg	0 / 10	--	--	--	--
Iron	mg/kg	2 / 2	31,000.00	35,266.67	33,133.33	33,998.03
Lead	mg/kg	69 / 69	5.30	246.00	48.92	37.33
Magnesium	mg/kg	2 / 2	11,100.00	12,000.00	11,550.00	11,732.40
Manganese	mg/kg	2 / 2	300.00	362.67	331.33	344.03
Mercury	mg/kg	69 / 69	3.00E-03	8.30	0.65	0.48
Molybdenum	mg/kg	1 / 5	1.02	1.02	3.50	4.36
Nickel	mg/kg	69 / 69	29.30	212.00	91.76	86.80
Potassium	mg/kg	2 / 2	3,300.00	3,353.33	3,326.67	3,337.48
Selenium	mg/kg	51 / 69	0.08	6.09	0.50	0.27
Silver	mg/kg	67 / 69	0.02	1.12	0.36	0.28
Thallium	mg/kg	22 / 27	0.30	0.65	1.06	0.93
Vanadium	mg/kg	5 / 5	50.00	66.10	55.12	54.24
Zinc	mg/kg	69 / 69	25.30	549.00	144.90	123.58

Table K-3. Statistical Data Summary of Chemical Analysis for Sediment Samples
Galbraith Disposal Group
Port of Oakland 42-Foot Project Sediments

Parameter	Units	Number of Detects/Analyses	Minimum Detected Value	Maximum Detected Value	Arithmetic Mean	Volume Weighted Concentrations
<u>BUTYLTIINS</u>						
Dibutyltin	ug/kg	40 / 57	0.60	658.00	42.81	18.39
Monobutyltin	ug/kg	35 / 57	0.36	139.00	9.37	5.38
Tributyltin	ug/kg	60 / 65	0.60	2,600.00	194.11	81.28
Tetrabutyltin	ug/kg	4 / 10	0.59	4.15	0.89	0.42
<u>INORGANICS</u>						
Bromide	mg/kg	0 / 2	--	--	--	--
Calcium	mg/kg	2 / 2	3,900.00	4,121.67	4,010.83	4,055.76
Chloride	mg/kg	2 / 2	10,260.00	18,000.00	14,130.00	12,561.38
Clay	%	55 / 55	2.00	66.88	26.10	25.18
Fluoride	mg/kg	0 / 2	--	--	--	--
Gravel	%	11 / 11	0.02	1.89	0.27	0.41
Moisture	%	2 / 2	50.33	51.00	50.67	50.53
Nitrate as N	mg/kg	0 / 2	--	--	--	--
Sand	%	55 / 55	1.00	97.00	54.66	54.04
Silt	%	54 / 54	1.00	62.00	19.60	20.95
Sodium	mg/kg	2 / 2	9,720.00	10,000.00	9,860.00	9,803.25
Sulfate	mg/kg	2 / 2	2,210.00	4,690.00	3,450.00	2,947.39
Sulfide	mg/kg	11 / 11	56.30	8,600.00	1,348.63	778.70
Sulfides water soluble	mg/kg	9 / 9	107.00	535.00	261.56	230.77
Total Dissolved Solids	%	64 / 64	0.01	2.60	0.74	0.56
Total Organic Carbon	%	2 / 2	1,116.67	8,160.00	4,638.33	3,210.90
Total Organic Carbon	mg/kg	50 / 50	0.35	50.87	10.16	5.13
pH	pH	2 / 2	6.10	8.03	7.07	7.46

Bulk sediment data compiled from references listed on Table K-1.

Table K-4. Summary of Analytical Results - Elutriate Tests
Port of Oakland 42-Foot Project Sediments

Parameter	Inner Harbor Composite ¹ Mean of Replicates Dissolved (ug/l)	Outer Harbor Composite ¹ Mean of Replicates Dissolved (ug/l)	Turning Basin Wings Composite ²	
			Dissolved (ug/l)	Total (ug/l)
METALS				
Silver	0.0267	0.01	--	--
Arsenic	3.11	3.18	1.59 - 6.347 (3.97)*	1.703 - 8.213 (4.958)
Cadmium	0.2173	0.2867	0.097 - 0.102 (0.100)	0.058 - 0.131 (0.095)
Chromium	0.79	0.45	3.373 - 4.003 (3.688)	3.843 - 4.143 (3.993)
Copper	4.65	33.6	0.557 - 0.893 (0.725)	1.24 - 3.43 (2.34)
Mercury	0.0407	0.0067	0.002 - 0.004 (0.003)	0.002 - 0.013 (0.008)
Nickel	4.66	4.21	--	--
Lead	3.55	2.98	15.967 - 18.667 (17.317)	19.4 - 20.3 (19.9)
Selenium	bd	bd	--	--
Zinc	34.4	45.9	8.333 - 11.667 (1)	10 - 14.167 (12.08)
INORGANICS				
Total phosphorous	--	--	138 - 310 (224)	155 - 390 (273)
Orthophosphate	--	--	55 - 208 (132)	64 - 290 (177)
Nitrate nitrogen	--	--	165 - 374 (270)	144 - 278 (211)
Ammonia nitrogen	--	--	8,597 - 13,333 (10,965)	8,860 - 13,900 (11,380)
Total organic carbon	--	--	1,067 - 1,900 (1,484)	1,000 - 2,167 (1,084)
pH	7.6	7.5	8.07 - 8.11 (8.09)	--
Dissolved oxygen	5.9 - 7.4	9	8.49 - 8.5 (8.495)	--
Salinity (ppt)	28	26	15.9	--
Conductivity (mmhos/cm)	--	--	24,667 - 26,000 (25,334)	--
BUTYL TINS				
Tributyltin	0.24	0.0107	0.006 - 0.013 (0.001)*	0.01545 - 0.03579 (0.0256)
Dibutyltin	0.0258	0.0329	0.008 - 0.054 (0.031)	0.00588 - 0.05619 (0.0310)
Monobutyltin	0.0164	0.0113	0.002	0.00296 - 0.00395 (0.0034)

Table K-4. Summary of Analytical Results - Elutriate Tests
Port of Oakland 42-Foot Project Sediments

Parameter	Inner Harbor Composite ¹ Mean of Replicates Dissolved (ug/l)	Outer Harbor Composite ¹ Mean of Replicates Dissolved (ug/l)	Turning Basin Wings Composite ²	
			Dissolved (ug/l)	Total (ug/l)
PAH				
Naphthalene	0.007	0.1155	--	--
Acenaphthylene	bd	0.0176	--	--
Acenaphthene	bd	0.0439	--	--
Fluorene	bd	0.0351	--	--
Phenanthrene	bd	0.0468	--	--
Anthracene	0.0354	0.0205	--	--
Fluoranthene	0.0136	0.0292	--	--
Pyrene	0.031	0.022	--	--
Benz(a)fluoranthene	bd	0.0205	--	--
Chrysene	bd	0.0176	--	--
Benzo(k)fluoranthene	bd	0.022	--	--
Benzo(b)fluoranthene	0.019	0.022	--	--
Benzo(a)pyrene	bd	0.0176	--	--
Indeno(1,2,3-cd)pyrene	bd	0.0278	--	--
Dibenz(a,h)anthracene	bd	0.0161	--	--
Benzo(g,h,i)perylene	0.0085	0.014	--	--

Notes:

* = minimum - maximum (mean)

ug/l = micrograms per liter

bd = below detection limit, detection limit not specified

¹ = Lee et al, 1993

² = Lee et al, 1992

Table K-5. Summary of Analytical Results - Rainfall Simulator/Lysimeter Tests
Port of Oakland 42-Foot Project Sediments

Parameter	Inner/Outer Harbor ¹ and Turning Basin Wings ²			
	Wet Sediment		Dry Sediment	
	Unfiltered	Filtered	Unfiltered	Filtered
METALS, ug/l				
Arsenic	16.9 - 36.5 (27) *	1.83 - 17.9 (8.58)	0.301 - 5.29 (2.80)	<DL - 2.96 (1.68)
Silver	0.16 - 0.21 (0.19)	0.14 - 0.18 (0.16)	1.11 - 1.45 (1.28)	0.93 - 1.22 (1.08)
Cadmium	3.19 - 9.12 (5.9)	0.209 - 0.99 (0.444)	0.94 - 2.69 (1.3)	0.1 - 0.423 (0.309)
Chromium	69.3 - 603 (325)	0.868 - 2.97 (1.89)	1.45 - 34.0 (16.8)	0.189 - 1.3 (0.743)
Copper	155 - 516 (278)	4.97 - 6.66 (5.99)	47.6 - 84.4 (67)	3.29 - 3.87 (3.62)
Mercury	<DL - 0.003 (0.0017)	0.0003 - 0.098 (0.047)	0.0002 - 0.113 (0.035)	0.0009 - 0.027 (0.0097)
Lead	46 - 458 (225)	0.71 - 1.01 (0.891)	22 - 54 (37)	0.34 - 1.51 (0.797)
Zinc	294 - 1,590 (714)	16.2 - 35.9 (26.8)	125 - 394 (220)	8.41 - 68.4 (33.9)
BUTYLINS, ng/l				
Tetrabutyltin	1.81 - 2.14 (1.98)	1.26 - 1.49 (1.38)	2.85 - 3.38 (3.12)	1.98 - 2.35 (2.17)
Tributyltin	16 - 300 (96)	3 - 22.5 (9.5)	5.42 - 51 (23)	2.54 - 34 (13.5)
Dibutyltin	13 - 86 (33.7)	7.19 - 44 (20)	10.0 - 24 (14.5)	4.79 - 20 (10.92)
Monobutyltin	<DL - 5.64 (4.1)	<DL - 3 (2.3)	3 - 13.2 (9.45)	<DL - 5.63 (4.09)
INORGANICS				
Suspended solids (mg/l)	2,920 - 9,140 (5,279)		970 - 1,749 (1,519)	
pH	7.97 - 8.29 (8.15)		6.88 - 7.69 (7.17)	
Elect. conductivity (mV/cm)	0.99 - 26.4 (11.8)		2.2 - 4.25 (2.96)	

Notes:

- * = minimum - maximum (mean)
- DL = detection limit (unspecified)
- ug/l = micrograms per liter
- ng/l = nanograms per liter
- mg/l = milligrams per liter
- ¹ = Lee et al, 1993
- ² = Lee et al, 1992

Table K-6. Summary of Analytical Results - Waste Extraction Tests
Port of Oakland 42-Foot Project Sediments

Parameter	Galbraith WET Results Inner/Outer Harbor Turning Basin (mg/l) *	STLC Criteria (mg/l)	10x STLC (mg/l)	Galbraith WET Data Set Inner/Outer Harbor Turning Basin Maximum Value (mg/kg)	Galbraith Entire Data Set	
					Bulk Chemistry Maximum Value Dry Weight (mg/kg)	Bulk Chemistry Mean Value Dry Weight (mg/kg)
Antimony	<0.1-<0.5(0.12)	15	150	NC	18.83	4.53
Arsenic	0.026-0.16(0.04)	5	50	NC	28.91	8.71
Barium	0.2-3.9(0.99)	100	1,000	NC	104	66.92
Beryllium	<0.005-	0.75	7.5	NC	0.65	0.38
Cadmium	<0.05(0.021)	1	10	NC	8.04	0.77
Hexavalent Chromium	0.006- <0.05(0.02)	5	50	NC	--	--
Chromium	<0.01- <0.27(0.01)	560	5,650	NC	930	359.99
Cobalt	0.1-9.5(1.3)	80	800	NC	13.73	10.14
Copper	0.053- <0.21(0.12)	25	250	423	423	70.09
Lead	0.007-0.2(0.08)	5	50	180	246	48.92
Mercury	<0.1-1.2(0.43)	0.2	2	1.6	8.3	0.65
Molybdenum	<0.001-	350	3,500	NC	1.02	3.5
Nickel	<0.01(0.004)	20	200	180	212	91.76
Selenium	<0.01- <0.1(0.04)	1	10	NC	6.09	0.50
Silver	0.14-3.6(0.63)	5	50	NC	1.12	0.36
Thallium	<0.0005-	7	70	NC	0.65	1.06
Vanadium	<0.05(0.018)	24	240	NC	66.1	55.12
Zinc	<0.003- <0.1(0.04)	250	2,500	NC	549	144.90
	<0.1- <0.5(0.1)					
	0.1-1.4(0.66)					
	<0.1-9.7(2)					

Table K-6. Summary of Analytical Results - Waste Extraction Tests
Port of Oakland 42-Foot Project Sediments

Parameter	Galbraith WET Results Inner/Outer Harbor Turning Basin (mg/l) *	STLC Criteria (mg/l)	10x STLC (mg/l)	Galbraith WET Data Set Inner/Outer Harbor Turning Basin Maximum Value (mg/kg)	Galbraith Entire Data Set	
					Bulk Chemistry Maximum Value Dry Weight (mg/kg)	Bulk Chemistry Mean Value Dry Weight (mg/kg)
Aldrin* *	--	0.14	1.4	ND	ND	ND
Chlordane	<0.005	0.25	2.5	ND	ND	ND
DDT, DDE, DDD	--	0.1	1	0.0022	0.02684	0.00297
2,4-D	--	10	100	--	--	--
Dieldrin	--	0.8	8	ND	0.01497	0.00164
Dioxin	--	0.001	0.01	--	--	--
Endrin	<0.005	0.02	0.2	ND	ND	ND
Heptachlor	<0.005	0.47	4.7	ND	0.00381	0.00102
Kepone	--	2.1	21	--	--	--
Organic Lead	<0.12	--	--	--	--	--
g-BHC (Lindane)	<0.0005	0.4	4	ND	0.00054	0.00105
Methoxychlor	<0.001	10	100	ND	ND	ND
Mirex	--	2.1	21	--	--	--
Pentachlorophenol	<0.01	1.7	17	ND	ND	ND
PCBs	--	5	50	0.032	0.7452	0.08835
Toxaphene	<0.01	0.5	5	ND	ND	ND
Trichloroethylene	<0.005	204	2,040	ND	ND	ND
2,4,5-TP	--	1	10	--	--	--

NC Not calculated

* Maximum values listed for organics due to infrequent detections

* * Minimum-maximum (mean); mean calculated using 1/2 the detection limit for non-detect values

Values in bold exceed 10x the STLC criteria

Test data from HLA, 1994 compilation; WET results from Battalle, 1993b,c; HLA, 1989; COE and Battelle, 1993; and WCC, 1988.

Table K-7. Summary of Analytical Results
Kinetic Batch Leach Tests
Port of Oakland 42-Foot Project Sediments

Parameter	Anaerobic Sediment*		Anaerobic Sediment**	Aerobic Sediment***
	Inner Harbor Leachate ¹	Outer Harbor Leachate ¹	Turning Basin Wings Leachate ²	Turning Basin Wings Leachate ²
METALS (ug/l)				
Arsenic	4.41 - 8.55 (6.63)#	14.5 - 145 (70.45)	16.3 - 153.3 (72.1)	0.9 - 1.6 (0.84)
Zinc	14.6 - 59.8 (27.0)	25.8 - 58.8 (37.3)	22.4 - 105.4 (37.8)	23.3 - 70.0 (46.1)
Copper	7.34 - 10.1 (9.25)	34.1 - 56.4 (46.5)	0.7 - 4.0 (1.8)	5.7 - 22.8 (11.8)
Nickel	8.35 - 22.8 (14.1)	44.8 - 61.5 (54.6)	--	--
Chromium	5.16 - 6.99 (5.79)	4.29 - 14.2 (8.9)	0.1 - 4.0 (1.7)	0.8 - 3.2 (1.5)
Silver	0.53 - 0.70 (0.59)	1.36 - 1.86 (1.66)	--	--
Lead	0.32 - 1.85 (0.80)	0.71 - 2.15 (1.08)	--	--
Cadmium	0.38 - 0.98 (0.54)	0.31 - <1.00 (0.52)	0.05 - 0.5 (0.13)	0.9 - 2.2 (1.7)
Mercury	0.03 - 0.14 (0.06)	0.01 - 0.09 (0.06)	0.002 - 0.43 (0.072)	0.004 - 0.026 (0.012)
BUTYLTIN (ng/l)				
Mono-butyltin	0.35 - 1.93 (1.08)	0.83 - 5.53 (2.59)	1.4 - 82.7 (29.5)	--
Di-butyltin	2.47 - 6.5 (4.69)	2.77 - 5.85 (3.94)	2.0 - 13.0 (7.2)	--
Tri-butyltin	1.9 - 3.63 (2.64)	1.23 - 5.73 (3.57)	9.8 - 18.0 (14.2)	--
Tetra-butyltin	1.1 - 2.6 (1.56)	0.8 - 2.9 (1.69)	--	--
PAH (ng/l)				
Benzo(b,j,k)-fluoranthene	4.1 - 5.4 (3.98)	3.65 - 13.1 (6.34)	--	--
Benzo(a)-pyrene	<4.1 - 4.7 (3.46)	<4.3 - 14.0 (7.30)	--	--
Naphthalene	<27.0 - 87.3 (32.5)	50.0 - 302 (165)	--	--
Phenanthrene	3.77 - <19.9 (7.89)	5.07 - 85.2 (32.0)	--	--
Fluoranthrene	0.35 - 8.27 (3.21)	6.75 - <7.9 (5.84)	--	--
Pyrene	42.1 - 57.9 (52.1)	10.4 - 55.7 (38.2)	--	--
Benzo(a)-anthracene	<4.8 - 5.4 (4.0)	0.31 - 7.34 (3.9)	--	--
Chrysene	4.23 - 5.7 (5.0)	4.5 - 9.87 (6.49)	--	--
Anthracene	1.8 - <4.9 (2.1)	<5.0 - 11.5 (6.7)	--	--
Acenaphthene	4.5 - 11.2 (7.0)	26.3 - 30 (27.9)	--	--
Benzo(g,h,i)-perylene	--	<3.5 - 10.0 (4.9)	--	--
Acenaphthylene	--	1.47 - 12.5 (4.74)	--	--
Fluorene	--	6.47 - 30 (14.8)	--	--

* PAH: mean was calculated using 3 sampling times; metals: mean was calculated using 6 sampling times.

** metals: mean was calculated using 8 sampling times; butyltins: mean was calculated using 2 sampling times.

*** mean calculated using 4 sampling times.

ug/l micrograms per liter; ng/l = nanograms per liter.

minimum - maximum (mean).

For nondetects, one half the detection limit was used to calculate the mean.

¹ Lee et al, 1993

² Lee et al, 1992

Table K-8. Summary of Analytical Results, Sequential Batch Tests
Port of Oakland 42-Foot Project Sediments (page 1 of 2)

Parameter	Anaerobic Inner Harbor		Anaerobic Outer Harbor		Anaerobic Turning Basin Wings	
	Sediment *	Leachate	Sediment *	Leachate	Sediment *	Leachate
METALS	mg/kg	ug/l	mg/kg	ug/l	mg/kg	ug/l
As	5.27-5.60(5.41) **	5.58-22.1(12.55)	6.26-6.78(6.47)	<0.94-40.1(22.8)	4.89-10.08(7.41)	1.8-52.79(24.0)
Zn	59.2-61.0(60.2)	17.5-135(67.5)	83.1-84.7(83.8)	16.5-162(60.5)	76.26-218.18(147.2)	19.0-176.7(79.1)
Cu	23.7-24.5(24.0)	11.3-44.8(28.1)	29.2-31.0(29.9)	9.78-249(66.5)	39.57-102.49(70.3)	2.2-311.9(102.5)
Ni	64.6-65.0(64.8)	7.86-40.1(21.8)	83.3-84.0(83.6)	6.96-75.5(26.94)	--	--
Cr	381.0-381.2(381.1)	2.63-28.3(10.80)	363.5-364.0(363.7)	3.04-60.7(18.52)	319.73-585.79(452.6)	2.0-234(64.8)
Ag	0.09-0.11(0.10)	0.38-0.88(0.56)	0.20	0.25-0.48(0.33)	--	--
Pb	13.0-14.1(13.9)	0.74-19.3(8)	18.0-18.7(18.2)	1.39-89.6(25.26)	--	--
Cd	0.142-0.146(0.143)	0.10-<1.00(0.43)	0.22-0.23(0.23)	0.15-1.04(0.42)	0.3527-0.989(0.656)	0.2-1.4(0.657)
Hg	0.11	0.01-<1.00(0.08)	0.17	<0.01-0.47(0.09)	0.5345-1.0119(0.7734)	0.006-0.12(0.033)
BUTYLTIN	ug/kg	ng/l	ug/kg	ng/l	ug/kg	ng/l
Mono-butyltin	0.11-0.18(0.15)	1.27-5.8(3.66)	0.77-0.83(0.80)	1.03-<215.1(20.59)	1.629-18.49(10.02)	3.1-36.1(12.7)
Di-butyltin	4.19-4.49(4.28)	1.07-33.5(14.1)	2.28-2.50(2.38)	0.5-28.1(9.3)	6.924-153.45(79.9)	10.0-128.3(43.5)
Tri-butyltin	4.80-5.01(4.92)	9.6-13.0(11.25)	2.61-2.86(2.70)	1.33-25.4(10.76)	34.95-701.4(367)	23.7-384.7(101.4)
Tetra-butyltin	<1.6-<3.6	--	<1.1-<3.5	--	--	--
pH	--	7.40-7.84(7.64)	--	7.13-7.70(7.27)	--	7.1-9.8(8.2)
Conductivity (millisiemens)	--	0.061-4.13(0.873)	--	0.10-6.57(1.55)	--	0.03-85.2(9.9)
PAH	ug/kg	ng/l	ug/kg	ng/l	ug/kg	ng/l
Benzo(bjk)-fluoranthene	150.5-152.7(151.7)	<13.4-159(83.3)	130.1-132.0(131.2)	<13.4-157(69.4)	--	--
Benzo(a)-pyrene	108.7-110.0(109.4)	<8.9-92.7(50.4)	91.4-92.0(91.8)	<9.0-66.8(23.7)	--	--
Indeno(1,2,3-cd)-pyrene	85.6-86.0(85.8)	<8.9-26.8(17.3)	91.4-91.6(91.5)	8.23-31.0(11.58)	--	--
Benzo(ghi)-perylene	108.8-109.3(109.1)	<8.9-34.6(23.0)	119.2-119.6(119.5)	<9.0-52.3(19.1)	--	--
Naphthalene	7.25-7.86(7.52)	17.7-43.9(31.4)	7.42-7.90(7.65)	16.7-43.8(24.1)	--	--
Phenanthrene	23.4-24.3(23.9)	18.2-63.7(40.9)	22.9-23.4(23.2)	21.1-40.0(24.9)	--	--
Fluoranthrene	69.6-71.0(70.3)	8.77-87.2(57.9)	48.5-49.9(49.3)	18.7-109(61.1)	--	--
Pyrene	118.7-123.1(120.9)	56.0-332(193.8)	80.7-83.9(82.7)	18.4-291(135.8)	--	--
Benzo(a)-anthracene	41.2-41.7(41.5)	7.7-27.3(18.9)	39.7-40.0(39.9)	<9.0-37.6(17.2)	--	--
Chrysene	44.6-45.0(44.8)	<8.9-33.4(18.2)	49.9-50.3(50.1)	6.3-43.8(16.4)	--	--
Acenaphthylene	3.27-3.33(3.30)	6.4-22.2(10.2)	--	--	--	--
Fluorene	2.96-3.00(2.98)	5.3-22.2(9.70)	--	--	--	--
Anthracene	6.96-7.00(6.97)	<8.9-22.2(10.7)	--	--	--	--
Acenaphthene	4.94-5.0(4.97)	--	--	--	--	--

mg/kg = milligrams per kilograms; ug/l = micrograms per liter; ug/kg = micrograms per kilogram; ng/l = nanograms per liter

* Range(mean) of sediment after each leach cycle

** minimum - maximum (mean)

For nondetects, one half the detection limit was used to calculate the mean.

Range of samples was treated as two different samples for calculating the mean.

For metals, pH, conductivity, mean was calculated using 7 leach cycles; for Turning Basin Wings, Lower and Upper samples averaged together.

For Inner/Outer Harbor butyltins, mean was calculated using 6 leach cycles; for Turning Bains Wings, mean was calculated using 5 leach cycles.

For PAH, the mean was calculated using 6 leach cycles.

Table K-8. Summary of Analytical Results, Sequential Batch Tests
Port of Oakland 42-Foot Project Sediments (page 2 of 2)

Parameter	Aerobic Inner Harbor		Aerobic Outer Harbor		Aerobic Turning Basin Wings	
	Sediment	Leachate	Sediment	Leachate	Sediment	Leachate
METALS	mg/kg	ug/l	mg/kg	ug/l	mg/kg	ug/l
As	5.17-5.60(5.36)	3.93-29.6(16.2)	6.11-6.81(6.42)	18.7-45.7(28.2)	5.202-10.19(7.66)	<0.95-27.7(11.56)
Zn	59.1-61.1(59.9)	8.17-227(70.75)	81.9-84.3(82.8)	42.0-196.7(104.2)	75.94-218.85(147.01)	19-196.3(90.86)
Cu	23.2-24.5(23.7)	15.3-142.8(46.1)	29.0-30.6(29.6)	28.9-137.5(73.2)	39.59-102.45(70.77)	6.8-142.6(60.5)
Ni	64.3-65.2(64.6)	4.70-99.4(32.6)	82.9-83.8(83.2)	17.0-85.9(42.3)	--	--
Cr	380.4-381.2(380.7)	2.90-96.3(30.5)	362.8-363.8(363.2)	16.4-83.0(43.2)	320.25-585.8(452.8)	0.9-171.9(51.6)
Ag	0.078-0.107(0.092)	0.75-1.27(1.14)	0.165-0.198(0.182)	1.21-1.73(1.38)	--	--
Pb	13.5-14.1(13.7)	2.91-82.8(23.7)	17.5-18.5(17.8)	17.8-81.3(43.2)	--	--
Cd	0.109-0.147(0.115)	0.01-0.08(0.03)	0.212-0.229(0.219)	0.38-1.50(0.76)	0.3472-0.9564(0.6518)	0.2-2.47(0.688)
Hg	0.109-0.110(0.109)	0.01-0.08(0.03)	0.1655-0.1658(0.1656)	0.005-0.051(0.019)	0.5358-1.0119(0.7739)	0.005-0.016(0.0085)
BUTYLtin	ug/kg	ng/l	ug/kg	ng/l	ug/kg	ng/l
Mono-butyltin	<5.1	0.29-6.70(4.23)	<5.1	2.31-16.0(10.34)	1.749-18.45(9.8)	2.5-196.3(34.32)
Di-butyltin	3.80-3.99(3.88)	4.10-26.6(12.61)	<1.4- <2.1	8.00-31.5(19.5)	7.068-153.47(79.9)	8.3-199.7(32.82)
Tri-butyltin	<2.0	2.0-17.4(6.22)	2.05-2.50(2.23)	12.3-50.8(27.0)	34.95-701.39(366.7)	14.3-1015(168.7)
pH	--	6.78-7.40(7.09)	--	6.53-7.47(7.16)	--	6.1-7.6(7.0)
Conductivity (millisiemens)	--	0.03-0.74(0.18)	--	0.05-0.61(0.17)	--	0.02-39.6(5.8)
PAH	ug/kg	ng/l	ug/kg	ng/l	ug/kg	ng/l
Benzo(bjk)-fluoranthene	94.4	--	86	2.79-	--	--
Benzo(a)-pyrene	69.0	--	53.8	<28.01(11.95)	--	--
Indeno(1,2,3-cd)-pyrene	56.9	--	24.4	0.52- <6.39(2.75)	--	--
Benzo(ghi)-perylene	45.2	--	18.2	--	--	--
Naphthalene	<2.1	25.2-48.3(35.0)	<3.1	--	--	--
Phenanthrene	<19.7	2.83-6.53(4.85)	20.3	27.4-58.7(40.9)	--	--
Fluoranthrene	82.2	2.24-4.96(3.18)	58.6	3.90-5.82(4.97)	--	--
Pyrene	143.5	4.80-15.2(8.74)	105.7	2.41-9.32(4.08)	--	--
Benzo(a)-anthracene	<2.1	--	25	3.82-24.7(8.63)	--	--
Chrysene	30.3	--	34.1	1.19- <30.2(10.77)	--	--
Acenaphthylene	<2.1	0.96-	<3.1	0.89- <19.2(7.11)	--	--
Fluorene	<2.1	<9.17(3.36)	<3.1	--	--	--
Anthracene	<2.1	2.14-4.94(3.20)	<3.1	1.82-3.63(3.11)	--	--
Acenaphthene	<2.1	--	<3.1	--	--	--
		4.10-		1.16-3.47(2.31)		
		<5.87(3.45)				

mg/kg = milligrams per kilograms; ug/l = micrograms per liter; ug/kg = micrograms per kilogram; ng/l = nanograms per liter

* Range(mean) of sediment after each leach cycle

** minimum - maximum (mean)

For nondetects, one half the detection limit was used to calculate the mean.

Range of samples was treated as two different samples for calculating the mean.

For metals, pH, conductivity, mean was calculated using 7 leach cycles; for Turning Basin Wings, Lower and Upper samples averaged together.

For Inner/Outer Harbor butyltins, mean was calculated using 6 leach cycles; for Turning Bains Wings, mean was calculated using 5 leach cycles.

For PAH, the mean was calculated using 6 leach cycles.

Table K-9. Summary of Analytical Results
Rainwater Extraction/Pore Water Tests
Port of Oakland 42-Foot Project Sediments

Parameter	Turning Basin Sediments ¹ Simulated Rainwater Extraction n = 4	Turning Basin Sediments ² Pore Water n = 2 to 5
METALS (mg/l)		
Aluminum	<0.01 - 0.03 (0.018)*	0.065 - 0.081 (0.074)
Antimony	<0.005 - <0.1 (0.02)	--
Arsenic	0.0008 - 0.015 ((0.009)	0.043 - 0.044 (0.0435)
Barium	0.02 - 0.07 (0.044)	0.066 - 0.164 (0.106)
Beryllium	<0.005	<0.005
Cadmium	<0.0005 - 0.004 (0.002)	<0.004 - 0.0002 (0.0013)
Calcium	29.1 - 33.4 (30.9)	233 - 329 (276)
Chromium	<0.01	<0.010 - 0.002 (0.0037)
Cobalt	<0.01 - 0.015 (0.008)	<0.010
Copper	<0.005 - 0.0068 (0.004)	0.029 - 0.068 (0.046)
Iron	0.09 - 24.5 (16.2)	0.053 - 0.3 (0.208)
Lead	0.002 - <0.03 (0.008)	0.030 - 0.070 (0.050)
Manganese	46.2 - 65.7 (54.8)	851 - 1,050 (933)
Manganese	1 - 1.53 (1.18)	0.980 - 2.9 (1.643)
Mercury	<0.0002	0.00008 - 0.0002 (0.00014)
Molybdenum	<0.01 - 0.012 (0.007)	0.060 - 0.074 (0.067)
Nickel	<0.01 - 0.041 (0.016)	<0.010 - 0.032 (0.020)
Potassium	41.2 - 52.7 (44.1)	241 - 294 (276)
Selenium	<0.0003	--
Silver	<0.001 - <0.003 (0.0013)	<0.0003
Sodium	54.2 - 600 (424)	7,670 - 9,220 (8,220)
Thallium	<0.001	--
Vanadium	<0.005 - 0.006 (0.003)	<0.005 - 0.021 (0.0108)
Zinc	0.007 - 0.009 (0.008)	0.024 - 0.067 (0.049)
MISC. INORGANICS (mg/l)		
Alkalinity as CaCO ₃	381 - 520 (426)	--
Bromide	<20	<1,000
Chloride	625 - 870 (759)	7,350 - 13,000 (9,633)
Cyanide	<0.001 - 0.002 (0.001)	--
Fluoride	<50	<2,500
Nitrate/Nitrite as N	<10 - <20 (13.75)	<1,000
Sulfates	<20 - 65 (35)	(1,000 - 1,210 (737)
Total Sulfides	<0.01 - <0.04 (0.009)	--
Total Dissolved Solids	15.5 - 1,960 (1,384)	--
pH	6.1 - 6.8 (6.4)	--
BUTYL TINS (ng/l)		
Monobutyltin	<5	<5 - 159 (47.3)
Dibutyltin	<5 - 42 (22.2)	6 - 111 (47.4)
Tributyltin	<5 - 190 (90.1)	12 - 310 (173)
MISC. ORGANICS (ug/l)		
Bromodichloromethane	--	<1 - 10 (6.77)
Bromoform	--	12 - 260 (237)
Chloroform	--	<0.5 - 2.1 (1.42)
Dibromochloromethane	--	2.5 - 68 (37.2)
Petroleum Hydrocarbons	--	<10,000
Total Trihalomethane Formation Potential	--	14 - 520 (282)

* Minimum - Maximum (mean); n = number of samples
1/2 of the detection limit used in calculation of the mean

1. HLA 1989.
2. HLA 1989; Lee et al. 1992.

Table K-10. Wetland plant and animal test data

Parameter	Inner Oakland Harbor 39'			Inner Oakland Harbor 44'		
	Snails	Clams	Mussels	Snails	Clams	Mussels
<u>METALS</u> , ug/g dry wt.						
Ag	14.6	0.049-0.126(0.094)	0.490-0.840(0.69)	6.62-16.5(11.6)	0.045-0.871(0.33)	0.910-1.10(0.99)
As	26.4	35.2-42.3(37.7)	9.52-11.2(10.5)	24.4-36.5(30.4)	30.7-44.0(35.3)	11.0-12.0(11.4)
Cd	3.31	0.930-1.54(1.24)	1.38-1.89(1.59)	3.34-3.44(3.39)	1.03-1.39(1.67)	1.62-2.31(1.94)
Cr	12.0	3.86-9.48(6.65)	7.30-7.90(7.57)	5.20-11.0(8.10)	4.44-51.3(22.4)	7.10-8.20(7.50)
Cu	2290	13.2-17.2(15.7)	11.2-16.3(13.2)	2140-3140(2640)	13.7-17.5(16.1)	12.7-15.9(13.9)
Hg	0.684	0.152-0.302(0.22)	0.084-0.145(0.12)	0.680-0.841(0.76)	0.190-0.282(0.24)	0.066-0.09(0.08)
Ni	2.6	9.40-15.3(12.8)	1.20-1.60(1.37)	5.20-11.1(8.15)	13.3-107(45.6)	1.20-1.40(1.33)
Pb	2.00	3.67-6.45(5.47)	1.40-1.60(1.50)	1.70-2.00(1.85)	5.02-40.0(17.1)	1.50-1.80(1.63)
Se	4.57	1.92-3.04(2.59)	0.860-1.86(1.46)	4.78-7.32(6.05)	2.53-2.82(2.65)	0.930-1.82(1.45)
Zn	406	159-279(237)	47.6-56.7(52.7)	486-487(486)	183-227(198)	47.5-54.9(50.5)
<u>BUTYLTIN</u> , ug/kg wet wt.						
Tributyltin	4.80-11.6(7.97)	6.90-15.0(9.97)	11.8-31.6(21.9)	3.10-3.60(3.43)	4.30-4.70(4.53)	10.9-17.8(13.5)
Dibutyltin	3.50-6.20(4.63)	2.80-3.50(3.17)	7.80-10.5(8.90)	2.50-3.00(2.80)	1.80-7.50(3.83)	8.90-16.7(13.5)
Monobutyltin	2.70-2.90(2.77)	2.90-3.30(3.03)	2.60-3.40(2.87)	2.70-2.90(2.80)	2.80-3.30(3.07)	2.30-3.40(2.67)
Tripental	65.8-84.7(74.5)	62.7-99.0(75.0)	NA	88.5-105(96.3)	102-112(106)	NA
Tetrabutyltin	NA	NA	4.30-5.70(4.80)	NA	NA	3.80-5.70(4.47)
<u>PAH</u> , ug/kg wet wt.						
Naphthalene	5.71-8.95(6.81)	21.4-32.9(25.4)	63.0-134(91.8)	5.06-6.01(5.67)	13.8-20.6(18.3)	56.8-59.6(58.5)
Acenaphthene	2.70-3.02(2.85)	4.60-11.0(7.34)	4.43-9.61(6.18)	2.00-2.77(2.44)	3.51-4.04(3.69)	2.40-4.47(3.73)
Acenaphthylene	4.60-5.15(4.85)	7.99-19.1(12.7)	1.23-2.53(1.70)	3.41-4.71(4.16)	6.09-7.02(6.41)	0.920-1.35(1.20)
Fluorene	3.52-4.31(3.91)	5.32-12.0(8.28)	1.44-4.51(2.66)	2.63-3.62(3.20)	4.35-5.44(4.83)	0.760-2.87(2.16)
Phenanthrene	4.34-14.4(9.40)	13.9-21.5(17.7)	27.4-57.8(38.0)	4.32-7.34(5.86)	10.0-16.6(13.5)	15.1-48.7(34.1)
Anthracene	2.31-3.97(3.04)	3.40-7.69(5.30)	0.290-0.760(0.563)	1.73-2.37(2.10)	2.56-3.00(2.75)	0.390-0.470(0.44)
Fluoranthene	6.68-11.1(9.00)	11.3-31.9(18.9)	1.54-2.74(2.33)	3.17-5.41(4.22)	8.76-21.6(14.2)	1.37-2.87(1.98)
Pyrene	11.5-53.0(36.4)	65.8-82.7(72.1)	10.8-24.8(18.6)	6.42-15.7(10.3)	29.1-65.0(41.3)	8.28-15.6(12.2)
Benzo(a) Anthracene	1.54-3.34(2.44)	5.12-7.40(6.05)	0.240-1.23(0.700)	1.22-1.58(1.43)	2.90-7.00(4.57)	0.260-0.350(0.30)
Chrysene	3.62-7.40(5.80)	6.95-10.5(8.26)	0.520-1.30(1.03)	1.98-3.25(2.56)	4.14-10.1(6.48)	0.53-0.940(0.723)
Benzo(b) Fluoranthene	3.27-11.6(8.25)	12.0-12.3(12.1)	0.350-0.800(0.603)	2.25-4.59(3.58)	7.77-14.0(9.97)	0.30-0.390(0.350)
Benzo(k) Fluoranthene	2.76-7.83(5.70)	8.44-8.96(8.64)	0.170-0.450(0.327)	2.19-3.86(3.03)	5.44-10.9(7.39)	0.160-0.270(0.20)
Benzo(a) Pyrene	2.68-8.20(5.54)	10.7-12.7(11.4)	0.100-0.350(0.253)	2.09-3.62(3.01)	5.92-11.5(8.08)	0.140-1.32(0.537)
Indeno(1,2,3-cd) Pyrene	3.20-6.97(4.97)	3.57-5.16(4.18)	0.970-1.05(1.02)	2.40-4.25(3.23)	2.21-5.03(3.52)	0.990-1.58(1.21)
Dibenzo(a,h) Anthracene	0.950-2.06(1.52)	1.19-2.76(1.90)	0.660-0.710(0.693)	0.580-0.820(0.697)	0.940-1.33(1.11)	0.670-1.07(0.817)
Benzo(g,h,i) Perylene	3.83-8.52(6.38)	5.41-7.39(6.09)	0.860-1.77(1.35)	0.740-5.02(2.62)	3.09-6.23(4.57)	0.370-0.61(0.503)

* Bold and Italics Indicates Less Than Detection Limit

Table K-10. Wetland plant and animal test data (Continued)

Parameter	Inner Oakland Harbor 39'			Inner Oakland Harbor 44'		
	Snails	Clams	Mussels	Snails	Clams	Mussels
<u>PCBs,ug/kg wet wt.</u>						
Aroclor 1242	20	20.0	2.17-2.356(2.29)	20	20.0	2.22-3.54(2.68)
Aroclor 1248	20	20.0	2.17-2.356(2.29)	20	20.0	2.22-3.54(2.68)
Aroclor 1254	20	20.0	34.7-40.8(38.4)	20	20.0	34.70-40.76(40.2)
Aroclor 1260	20	20.0	2.17-2.356(2.29)	20	20.0	2.22-3.54(2.68)
<u>Pesticide,ug/kg wet wt</u>						
Alpha-BHC	2.00-2.97(2.32)	2.00-5.61(3.70)	0.076-0.082(0.080)	2.00-2.32(2.11)	2.00	0.083-0.24(0.167)
Beta-BHC	2.00	2.00	0.076-0.082(0.080)	2.00	2.00	0.071-0.124(0.09)
Delta-BHC	2.92-3.29(3.11)	2.00	0.076-0.082(0.080)	2.00-2.92(2.53)	2.00	0.071-0.286(0.16)
Gamma-BHC	2.00-3.11(2.70)	2.00	0.076-0.082(0.080)	2.00-2.47(2.16)	2.00-27.2(10.4)	0.079-3.43(1.89)
Heptachlor	2.00	2.00-2.73(2.24)	0.155-0.168(0.163)	2.00	2.00-2.37(2.12)	0.044-0.25(0.118)
Aldrin	2.00	2.00	0.080-0.208(0.123)	2.00	2.00	0.077-0.12(0.105)
Heptachlor Epoxide	2.00	2.00-4.09(2.88)	0.095-0.669(0.294)	2.00	2.00	0.122-0.272(0.18)
Gamma-Chlordane	2.00	2.00	NA	2.00	2.00	NA
Endosulfan I	2.00-3.34(2.45)	2.00	0.234-0.350(0.279)	2.00-2.04(2.01)	2.00-10.1(4.70)	0.184-0.273(0.22)
Alpha-Chlordane	2.00-2.71(2.24)	2.00-10.8(4.93)	NA	2.00	2.00	NA
Dieldrin	2.00	2.00	0.216-0.363(0.265)	2.00	2.00-12.8(5.60)	0.252-0.342(0.30)
DDE	4.34-6.29(5.55)	3.34-8.04(5.30)	2.44-3.31(2.88)	3.94-5.07(4.63)	2.00-5.33(3.79)	2.24-3.76(2.84)
Endrin	2.00	2.00	0.139-0.743(0.345)	2.00	2.00	0.132-1.22(0.708)
Endosulfan II	2.00	2.00	0.453-0.618(0.534)	2.00	2.00	0.31-0.684(0.467)
DDD	3.49-5.59(4.44)	2.00-3.28(2.43)	0.347-0.566(0.451)	2.91-3.57(3.16)	2.04-15.3(6.71)	0.592-1.98(1.27)
Endrin Aldehyde	2.00	2.00	0.118-0.972(0.424)	2.00	2.00	0.09-0.187(0.147)
Endosulfan Sulfate	2.00	2.00	0.517-1.43(0.862)	2.00	2.00	0.486-1.07(0.731)
DDT	2.00	2.00	0.517-0.669(0.577)	2.00	2.00	0.309-0.650(0.52)
Toxaphene	NA	NA	2.17-2.36(2.29)	NA	NA	2.22-3.54(2.68)
Chlordane	NA	NA	2.17-2.36(2.29)	NA	NA	2.22-3.50(2.66)

* Bold and Italics Indicates Less Than Detection Limit

Table K-10. Wetland plant and animal test data (Continued)

Parameter	Outer Oakland Harbor 44'			Inner Oakland Harbor 39'		
	Snails	Clams	Mussels	<i>S. subterminalis</i>	<i>S. alterniflora</i>	<i>S. foliosa</i>
<u>METALS</u> , ug/g dry wt.						
Ag	13.0-19.7(16.4)	0.081-0.149(0.120)	0.800-0.840(0.820)	NA	NA	NA
As	32.5-36.0(34.2)	33.0-38.1(35.0)	9.94-12.0(11.0)	0.950-0.960(0.955)	NA	0.570-0.610(0.59)
Cd	3.61-5.37(4.49)	1.10-1.36(1.24)	1.54-1.85(1.70)	0.027-0.051(0.039)	NA	0.027-0.093(0.06)
Cr	5.30-6.60(5.95)	5.91-7.19(6.73)	6.40-7.60(7.00)	7.60-9.40(8.50)	NA	6.20-6.70(6.45)
Cu	3220-5020(4120)	14.2-15.4(14.9)	11.6-12.2(11.9)	6.77-7.70(7.24)	NA	4.89-6.19(5.54)
Hg	0.906-1.16(1.04)	0.167-0.259(0.215)	0.028-0.116(0.072)	0.034-0.043(0.038)	NA	0.007-0.016(0.01)
Ni	3.90-5.50(4.70)	11.8-14.8(13.0)	1.20-1.40(1.30)	1.70-1.74(1.72)	NA	1.10-1.81(1.46)
Pb	1.70	4.35-5.84(5.04)	1.70	0.245-0.247(0.246)	NA	0.095-0.346(0.22)
Se	6.95-9.73(8.34)	2.65-2.89(2.80)	1.66-1.67(1.66)	0.960-1.00(0.980)	NA	0.450-0.470(0.46)
Zn	591-1177(884)	232-247(242)	50.3-64.3(57.3)	11.5-20.4(16.0)	NA	4.89-34.1(19.5)
<u>BUTYLTIN</u> , ug/kg wet wt.						
Tributyltin	2.30-3.00(2.70)	1.60-2.80(2.23)	7.10-13.4(10.2)	NA	NA	NA
Dibutyltin	1.70-3.60(2.50)	1.70-2.50(2.03)	2.80-6.50(4.65)	NA	NA	NA
Monobutyltin	2.70-2.90(2.80)	3.10-3.20(3.17)	2.00-2.80(2.40)	NA	NA	NA
Tripental	88.6-101(93.6)	47.0-117(89.5)	NA	NA	NA	NA
Tetrabutyltin	NA	NA	3.30-4.70(4.00)	NA	NA	NA
<u>PAH</u> , ug/kg wet wt.						
Naphthalene	5.39-8.70(6.84)	3.93-22.8(16.4)	77.1-99.4(89.6)	NA	NA	NA
Acenaphthene	2.72-3.22(3.03)	3.52-4.94(4.33)	4.89-7.66(6.37)	1.44	NA	3.22-7.75(5.48)
Acenaphthylene	4.63-5.48(5.16)	6.12-8.57(7.53)	1.58-2.06(1.82)	6.23	NA	6.58-9.59(8.08)
Fluorene	3.43-4.05(3.82)	4.23-5.92(5.21)	1.51-3.27(2.26)	1.09	NA	2.04-3.23(2.64)
Phenanthrene	5.49-7.21(6.29)	5.85-16.9(12.6)	32.2-50.5(50.0)	3.51	NA	6.20-12.1(9.15)
Anthracene	2.25-2.66(2.51)	2.71-3.72(3.29)	0.180-0.950(0.500)	0.280	NA	4.42-4.76(4.59)
Fluoranthene	3.71-4.29(3.98)	7.17-13.2(10.6)	1.06-1.69(1.41)	2.76	NA	3.17-4.66(3.92)
Pyrene	6.56-10.4(8.57)	23.3-35.4(28.4)	4.74-10.4(7.25)	1.17	NA	3.48-5.47(4.48)
Benzo(a) Anthracene	1.59-1.83(1.67)	3.25-4.62(3.89)	0.200-0.320(0.263)	4.61	NA	7.09-7.96(7.52)
Chrysene	2.51-4.00(3.11)	4.55-6.98(5.78)	0.450-0.810(0.650)	0.790	NA	1.19-11.5(6.34)
Benzo(b) Fluoranthene	1.76-3.78(2.64)	5.25-6.65(5.79)	0.230-0.540(0.337)	4.70	NA	7.23-8.12(7.68)
Benzo(k) Fluoranthene	1.83-3.19(2.36)	3.74-4.78(4.11)	0.140-0.250(0.190)	3.94	NA	6.06-6.80(6.43)
Benzo(a) Pyrene	1.48-2.41(1.81)	3.83-5.56(4.47)	0.140-0.870(0.403)	4.10	NA	7.80
Indeno(1,2,3-cd) Pyrene	1.88-3.69(2.80)	0.860-2.10(1.68)	0.910-1.04(0.987)	4.91	NA	7.56-8.49(8.02)
Dibenzo(a,h) Anthracene	0.830-0.950(0.903)	0.990-1.36(1.18)	0.620-0.710(0.673)	3.34	NA	5.78-8.71(7.24)
Benzo(g,h,i) Perylene	2.11-4.19(3.19)	2.77-3.19(2.92)	0.450-1.41(0.827)	6.66	NA	6.60-10.3(8.45)

* Bold and Italics Indicates Less Than Detection Limit

Table K-10. Wetland plant and animal test data (Continued)

Parameter	Outer Oakland Harbor 44'			Inner Oakland Harbor 39'		
	Snails	Clams	Mussels	<i>S. subterminalis</i>	<i>S. alterniflora</i>	<i>S. foliosa</i>
<u>PCBs,ug/kg wet wt.</u>						
Aroclor 1242	20	20.0	2.22-2.33(2.27)	11.0	NA	NA
Aroclor 1248	20	20.0	2.22-2.33(2.27)	11.0	NA	NA
Aroclor 1254	20	14.0-20.0(18.0)	36.3-38.6(37.4)	11.0	NA	NA
Aroclor 1260	20	20.0	2.22-2.33(2.27)	11.0	NA	NA
<u>Pesticide,ug/kg wet wt</u>						
Alpha-BHC	2.00-2.93(2.45)	2.00	0.071-0.131(0.101)	1.29	NA	0.665-15.0(7.84)
Beta-BHC	2.00	2.00	0.071-0.081(0.076)	0.385	NA	0.592-0.665(0.63)
Delta-BHC	2.00-3.83(3.00)	2.00	0.071-0.081(0.076)	0.385	NA	0.592-0.665(0.63)
Gamma-BHC	2.00-2.87(2.47)	2.00	0.081-2.59(1.34)	7.93	NA	7.15-28.3(17.7)
Heptachlor	2.00	2.00-19.2(8.10)	0.146-0.166(0.156)	1.43	NA	1.36-18.1(9.72)
Aldrin	2.00	2.00	0.079-0.109(0.094)	2.46	NA	3.00-40.4(21.7)
Heptachlor Epoxide	2.00	2.00	0.129-0.263(0.196)	3.05	NA	0.455-0.664(0.56)
Gamma-Chlordane	2.00	2.00-2.54(2.18)	NA	NA	NA	NA
Endosulfan I	2.00-2.80(2.27)	2.00	0.233-0.268(0.250)	2.19	NA	3.27-4.46(3.86)
Alpha-Chlordane	2.00	2.00	NA	NA	NA	NA
Dieldrin	2.00-2.72(2.35)	2.00	0.248-0.310(0.279)	2.32	NA	6.93-32.6(19.8)
DDE	5.73-9.31(7.21)	5.48-56.9(22.9)	2.52-3.03(2.77)	1.84	NA	0.906-6.10(3.50)
Endrin	2.00	2.00	0.115-0.156(0.136)	1.61	NA	5.82-6.54(6.18)
Endosulfan II	2.00	2.00-16.1	0.411-0.527(0.469)	1.04	NA	1.91-2.34(2.12)
DDD	4.20-5.94(5.01)	3.21-24.5(10.3)	0.857-5.12(2.99)	0.437	NA	0.448-10.9(5.67)
Endrin Aldehyde	2.00	2.00	0.233-0.248(0.240)	1.10	NA	1.70-1.91(1.80)
Endosulfan Sulfate	2.00	2.00	0.394-0.516(0.455)	1.10	NA	1.33-1.91(1.62)
DDT	2.00	2.00	0.594-0.773(0.684)	0.809	NA	1.40-10.9(6.14)
Toxaphene	NA	NA	2.05-2.33(2.19)	11.0	NA	17.0-19.0(18.0)
Chlordane	NA	NA	2.05-2.33(2.19)	11.0	NA	17.0-19.0(18.0)

* Bold and Italics Indicates Less Than Detection Limit

Table K-10. Wetland plant and animal test data (Continued)

Parameter	Inner Oakland Harbor 44'			Outer Oakland Harbor 44'		
	<i>S. subterminalis</i>	<i>S. alterniflora</i>	<i>S. foliosa</i>	<i>S. subterminalis</i>	<i>S. alterniflora</i>	<i>S. foliosa</i>
<u>METALS</u> , ug/g dry wt.						
Ag	NA	0	NA	NA	0	NA
As	1.30	0.994	0.920	1.30	0.990	0.910-0.970(0.94)
Cd	0.40-0.069(0.054)	0.060	0.103	0.0400	0.0200	0.07-0.115(0.094)
Cr	8.70-10.5(9.60)	0.994	4.60	7.80	0.990	4.00-5.90(4.95)
Cu	9.82-9.94(9.88)	2.19	6.47	11.0	0.990	6.86-7.44(7.15)
Hg	0.043-0.050(0.046)	0.032	0.0120	0.0430	0.0450	0.006-0.02(0.014)
Ni	1.60-2.07(1.84)	1.19	1.73	1.55	0.990	0.850-0.970(0.91)
Pb	0.238-0.394(0.316)	4.00	0.182	0.238	4.55	0.259-0.535(0.40)
Se	0.930-0.940(0.935)	0.994	0.710	0.930	0.990	0.67-0.720(0.695)
Zn	20.7-20.9(20.8)	2.78	40.4	23.5	3.37	29.2-108.9(69.0)
<u>BUTYLTIN</u> , ug/kg						
Tributyltin	NA	28.7	NA	NA	38.3	NA
Dibutyltin	NA	18.1	NA	NA	18.1	NA
Monobutyltin	NA	16.4	NA	NA	16.4	NA
Tetrabutyltin	NA	NA	NA	NA	NA	NA
<u>PAH</u> , ug/kg wet wt.						
Naphthalene	NA	26.8	NA	NA	51.1	NA
Acenaphthene	NA	2.82	NA	NA	6.56	11.4
Acenaphthylene	NA	4.58	NA	NA	8.17	21.1
Fluorene	NA	4.67	NA	NA	3.69	2.48
Phenanthrene	NA	18.0	NA	NA	21.4	5.95
Anthracene	NA	3.12	NA	NA	3.68	9.34
Fluoranthene	NA	5.10	NA	NA	5.51	2.75
Pyrene	NA	6.57	NA	NA	6.22	3.25
Benzo(a) Anthracene	NA	1.49	NA	NA	1.67	13.9
Chrysene	NA	1.76	NA	NA	1.94	1.35
Benzo(b) Fluoranthene	NA	7.75	NA	NA	8.05	15.9
Benzo(k) Fluoranthene	NA	6.49	NA	NA	6.74	13.3
Benzo(a) Pyrene	NA	6.76	NA	NA	7.02	13.9
Indeno(1,2,3-cd) Pyrene	NA	8.11	NA	NA	8.42	16.6
Dibenzo(a,h) Anthracene	NA	5.51	NA	NA	5.72	11.3
Benzo(g,h,i) Perylene	NA	11.0	NA	NA	11.4	22.6

* Bold and Italics Indicates Less Than Detection Limit

Table K-10. Wetland plant and animal test data (Concluded)

Parameter	Inner Oakland Harbor 44'			Outer Oakland Harbor 44'		
	<i>S. subterminalis</i>	<i>S. alterniflora</i>	<i>S. foliosa</i>	<i>S. subterminalis</i>	<i>S. alterniflora</i>	<i>S. foliosa</i>
<u>Pesticide, ug/kg wet wt</u>						
Alpha-BHC	NA	NA	NA	NA	NA	1.30
Beta-BHC	NA	NA	NA	NA	NA	1.30
Delta-BHC	NA	NA	NA	NA	NA	1.30
Gamma-BHC	NA	NA	NA	NA	NA	7.15
Heptachlor	NA	NA	NA	NA	NA	2.66
Aldrin	NA	NA	NA	NA	NA	2.77
Heptachlor Epoxide	NA	NA	NA	NA	NA	1.46
Gamma-Chlordane	NA	NA	NA	NA	NA	NA
Endosulfan I	NA	NA	NA	NA	NA	2.75
Alpha-Chlordane	NA	NA	NA	NA	NA	NA
Dieldrin	NA	NA	NA	NA	NA	13.6
DDE	NA	NA	NA	NA	NA	1.78
Endrin	NA	NA	NA	NA	NA	12.8
Endosulfan II	NA	NA	NA	NA	NA	3.74
DDD	NA	NA	NA	NA	NA	0.0780
Endrin Aldehyde	NA	NA	NA	NA	NA	3.74
Endosulfan Sulfate	NA	NA	NA	NA	NA	3.74
DDT	NA	NA	NA	NA	NA	2.74
Toxaphene	NA	NA	NA	NA	NA	37.4
Chlordane	NA	NA	NA	NA	NA	37.4

* Bold and Italics Indicates Less Than Detection Limit

Table K-11. Upland plant and animal test data

Parameter	Inner Oakland Harbor 44'			Outer Oakland Harbor 44'		
	<i>C. esculentus</i> ADW	<i>S. virginicus</i> ADW	Earthworm	<i>C. esculentus</i> ADW	<i>S. virginicus</i> ADW	Earthworm
<u>METALS</u> , ug/g dry wt.						
Ag	0.200	0.200	NA	3.42	0.200-1.99 (0.996)	NA
As	1.00	0.982-1.00 (0.991)	11.8	0.994	0.994-0.996 (0.995)	11.5
Cd	1.00	0.238-0.275 (0.25)	3.58	2.19	0.558-0.795 (0.677)	3.93
Cr	1.00	0.982-1.00 (0.991)	79.4	0.994	0.994-0.996 (0.995)	33.1
Cu	8.00	6.40-7.33 (7.00)	19.2	10.3	9.54-9.562 (9.55)	17.2
Hg	0.032	0.032	0.0780	0.032	0.032	0.0810
Ni	2.40	0.982-1.00 (0.991)	11.6	1.19	1.39-1.99 (1.69)	8.97
Pb	0.200	0.00-0.393 (0.197)	1.64	3.98	3.38-3.39 (3.38)	2.11
Se	1.00	0.982-1.00 (0.991)	3.34	14.7	0.994-0.996 (0.995)	3.74
Zn	62.2	12.8-22.8 (17.2)	107	100	38.0-45.5 (41.8)	93.8
<u>BUTYLTIN</u> , ug/kg wet wt.						
Tributyltin	101	8.50	NA	38.3	38.3	NA
Dibutyltin	18.1	18.1	NA	18.1	18.1	NA
Monobutyltin	16.4	16.4	NA	16.4	16.4	NA
Tetrabutyltin	NA	NA	NA	NA	NA	NA
<u>PAH</u> , ug/kg wet wt.						
Naphthalene	3.98	6.34	NA	2.78	6.93-10.6 (8.75)	NA
Acenaphthene	1.35	2.43	3.74	1.02	3.43-3.53 (3.48)	1.46
Acenaphthylene	3.90	4.33	0.870	1.83	6.8-7.59 (7.20)	5.03
Fluorene	1.06	2.18	3.23	1.06	1.97-2.65 (2.31)	1.04
Phenanthrene	5.26	10.6	16.9	5.24	10.3-14.3 (12.3)	4.75
Anthracene	1.19	1.09	5.47	0.730	1.44-1.98 (1.71)	2.39
Fluoranthene	1.11	2.92	38.1	1.19	3.33-4.05 (3.69)	12.3
Pyrene	1.43	2.59	379	1.42	2.74-3.04 (2.89)	86.8
Benzo (a) Anthracene	0.620	0.770	27.1	0.360	0.820-5.03 (2.92)	12.0
Chrysene	0.800	1.28	57.4	0.420	1.59-1.600 (1.60)	22.5
Benzo (b) Fluoranthene	2.94	4.69	118	0.570	5.13-5.73 (5.43)	33.1
Benzo (k) Fluoranthene	2.47	3.93	95.5	1.73	4.30-4.80 (4.55)	25.1
Benzo (a) Pyrene	2.57	4.09	NA	1.80	4.47-5.00 (4.74)	NA
Indeno (1,2,3-cd) Pyrene	3.08	4.91	7.78	2.15	5.36-5.99 (5.68)	3.97
Dibenzo (a,h) Anthracene	2.09	3.34	5.29	1.46	3.65-4.08 (3.86)	2.70
Benzo (g,h,i) Perylene	1.18	6.66	10.6	2.92	7.27-8.13 (7.70)	5.38

* Bold and Italics Indicates Less Than Detection Limit

Table K-11. Upland plant and animal test data (Continued)

Parameter	Inner Oakland Harbor 44'			Outer Oakland Harbor 44'		
	<i>C. esculentus</i> ADW	<i>S. virginicus</i> ADW	Earthworm	<i>C. esculentus</i> ADW	<i>S. virginicus</i> ADW	Earthworm
<u>PCBs</u> ,ug/kg wet wt.						
Aroclor 1242	NA	NA	17.5	NA	NA	8.90
Aroclor 1248	NA	NA	17.5	NA	NA	8.90
Aroclor 1254	NA	NA	320	NA	NA	105
Aroclor 1260	NA	NA	17.5	NA	NA	8.90
<u>Pesticide</u> ,ug/kg wet wt						
Alpha-BHC	NA	NA	0.609	NA	NA	0.311
Beta-BHC	NA	NA	0.609	NA	NA	0.311
Delta-BHC	NA	NA	5.94	NA	NA	0.311
Gamma-BHC	NA	NA	6.51	NA	NA	0.311
Heptachlor	NA	NA	2.05	NA	NA	0.635
Aldrin	NA	NA	1.22	NA	NA	6.65
Heptachlor Epoxide	NA	NA	1.22	NA	NA	0.945
Gamma-Chlordane	NA	NA	NA	NA	NA	NA
Endosulfan I	NA	NA	2.63	NA	NA	1.35
Alpha-Chlordane	NA	NA	NA	NA	NA	NA
Dieldrin	NA	NA	4.72	NA	NA	12.9
DDE	NA	NA	30.3	NA	NA	21.9
Endrin	NA	NA	6.00	NA	NA	5.90
Endosulfan II	NA	NA	2.30	NA	NA	6.24
DDD	NA	NA	29.3	NA	NA	25.6
Endrin Aldehyde	NA	NA	1.75	NA	NA	0.890
Endosulfan Sulfate	NA	NA	11.9	NA	NA	9.33
DDT	NA	NA	2.61	NA	NA	1.22
Toxaphene	NA	NA	17.5	NA	NA	8.90
Chlordane	NA	NA	17.5	NA	NA	8.90

* Bold and Italics Indicates Less Than Detection Limit

Table K-11. Upland plant and animal test data (Continued)

Parameter	Earthworm	
	Lower Turning Basin	Upper Turning Basin
<u>METALS</u> , ug/g dry wt.		
Ag	0.0600	0.100
As	52.5	63.1
Cd	7.62	7.23
Cr	2.72	2.02
Cu	26.6	26.9
Hg	0.268	0.252
Ni	8.03	9.04
Pb	2.19	2.81
Se	NA	NA
Zn	1.33	145
<u>BUTYLTIN</u> , ug/kg dry wt.		
Tributyltin	91.2	616
Dibutyltin	52.5	230
Monobutyltin	10.2	17.5
Tetrabutyltin	5.00	4.00
<u>PAH</u> , ug/kg dry wt.		
Naphthalene	2.00	1.00
Acenaphthene	2.00	1.00
Acenaphthylene	2.00	1.00
Fluorene	2.00	1.00
Phenanthrene	2.00	1.50
Anthracene	2.00	1.00
Fluoranthene	4.90	17.7
Pyrene	18.0	31.5
Benzo (a) Anthracene	3.50	1.00
Chrysene	5.90	9.30
Benzo (b,k) Fluoranthene	80.0	140
Benzo (a) Pyrene	5.00	7.60
Indeno (1,2,3-cd) Pyrene	8.00	3.50
Dibenzo (a,h) Anthracene	8.00	3.50
Benzo (g,h,i) Perylene	8.00	3.50

* Bold and Italics Indicates Less Than Detection Limit

Lower Turning Basin: 39-44'

Upper Turning Basin: 0-39'

Table K-11. Upland plant and animal test data (Concluded)

Parameter	Earthworm	
	Lower Turning Basin	Upper Turning Basin
<u>PCBs, ug/kg</u>		
Aroclor 1242	NA	NA
Aroclor 1248	<i>1000</i>	<i>1000</i>
Aroclor 1254	2625	2675
Aroclor 1260	<i>1000</i>	<i>1000</i>
<u>Pesticide, ug/g</u>		
Alpha-BHC	<i>0.220</i>	<i>0.200</i>
Beta-BHC	<i>0.160</i>	<i>0.150</i>
Delta-BHC	<i>0.110</i>	<i>0.0700</i>
Gamma-BHC	<i>0.100</i>	<i>0.0800</i>
Heptachlor	<i>0.0400</i>	<i>0.0600</i>
Aldrin	<i>0.100</i>	<i>0.120</i>
Heptachlor Epoxide	<i>0.200</i>	<i>0.0700</i>
Gamma-Chlordane	<i>0.850</i>	<i>0.0500</i>
Endosulfan I	<i>0.0800</i>	<i>0.0600</i>
Alpha-Chlordane	<i>0.750</i>	<i>0.0700</i>
Dieldrin	<i>0.0800</i>	<i>0.160</i>
DDE	<i>0.240</i>	<i>0.0900</i>
Endrin	<i>0.100</i>	<i>0.0900</i>
Endosulfan II	<i>0.0600</i>	<i>0.150</i>
DDD	<i>0.320</i>	NA
Endrin Aldehyde	NA	<i>0.0700</i>
Endosulfan Sulfate	<i>0.0900</i>	<i>0.0700</i>
DDT	<i>0.610</i>	<i>0.550</i>
Toxaphene	<i>2.00</i>	<i>1.50</i>
Chlordane	NA	NA
Methoxychlor	<i>0.0300</i>	<i>0.120</i>
Endrin Ketone	<i>0.0600</i>	<i>0.0200</i>

* Bold and Italics Indicates Less Than Detection Limit

Lower Turning Basin: 39-44'

Upper Turning Basin: 0-39'

APPENDIX L

Sediment Screening Criteria and Testing Requirements for Wetland Creation and Upland Beneficial Use

This appendix includes a copy of the Interim Final report titled *Sediment Screening Criteria and Testing Requirements for Wetland Creation and Upland Beneficial Reuse* (December 1992) prepared by John D. Wolfenden and Michael P. Carlin, staff of the California Environmental Protection Agency (CEPA) and California Regional Water Quality Control Board (CRWQCB). It also includes a summary of available comments received by the CRWQCB and the U.S. Army Corps of Engineers, San Francisco District on the report, and responses to those comments.

Interim
Sediment Screening Criteria and Testing Requirements for
Wetland Creation and Upland Beneficial Reuse

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Interim Final
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Sediment Screening Criteria and Testing Requirements for Wetland Creation and Upland Beneficial Reuse

1.0 Introduction

The San Francisco Bay Area has an annual aquatic dredged sediment disposal requirement of approximately 8 million cubic yards (mcy) of dredged material to maintain deep and shallow draft navigation channels. The Bay Area presently also has a one-time new work requirement of approximately 19 mcy for the Oakland Harbor, Richmond Harbor, John F. Baldwin ship channel and two Navy projects. Annually, more than \$5.4 billion of economic activity is directly dependent on the deep and shallow draft navigation channels of the San Francisco Bay region. Disposal in the San Francisco Bay Area takes place mainly at four in-bay disposal sites; the Alcatraz, Carquinez Strait, San Pablo Bay and Suisun Channel disposal sites. Insufficient capacity at the present disposal sites to accommodate maintenance and new work projects in the region has led to the formation of the Long Term Management Strategy (LTMS).

The LTMS is a US Army Corps of Engineers' (COE) national policy initiative. The purpose of the LTMS initiative is to secure timely, technically feasible, cost effective and environmentally acceptable disposal options in an orderly, sequential process. The LTMS development occurs in five phases: Phase I, evaluation of existing options; Phase II, formulation of alternatives; Phase III, analysis of alternatives; Phase IV, implementation; and Phase V, periodic review and update of the selected management strategy.

The San Francisco Bay LTMS was formed in January 1990 as a multi-participant effort to provide a mechanism for consensus building to solve regional disposal issues and concerns. It involves over thirty different participants including government agencies, environmental organizations, development interests, ports and fisherman groups. A management structure was discussed and approved by this group, now identified as the Policy Review Committee, in July 1990. Under this management structure, the LTMS is led by an Executive Committee which includes the COE's South Pacific Division Commander, the US EPA's Regional Administrator, the San Francisco Bay Regional Water Quality Control Board's Chairperson, the San Francisco Bay Conservation and Development Commission's Chairperson, and the Secretary of the California Environmental Protection Agency who serves as the State Coordinator. This group is advised regularly by the Policy Review Committee on all pertinent issues. Work is performed by a Management Committee chaired by the COE's San Francisco District Commander. This committee oversees the LTMS studies, budget, and schedule. The Management Committee is supported by the Work Groups: Ocean, In-Bay, Nonaquatic/reuse, and Implementation.

Nonaquatic/reuse, and Implementation.

The LTMS will culminate in 1994 with a long term dredged material disposal plan including detailed conclusions on the impacts of dredging and disposal, a range of recommended environmentally acceptable and economically and technically feasible disposal options, and a methodology for the use of each option.

1.1 Problems Associated with Dredging

The disposal of dredged material affects the Estuary's biological resources and water quality in several ways. Effects include the direct burial of organisms at the disposal site, increases in suspended sediments in the water column, reduced fishing success near the disposal area, and potential mobilization of pollutants previously bound in the bottom sediments. Disposal at the current "dispersive" sites may also result in impacts off-site as currents carry the dredged material to other parts of the Estuary.

Mounding at the main disposal site near Alcatraz Island is limiting the site's capacity. Federal and state resource agencies have commented that closure or further restriction of existing in-Bay disposal sites is warranted. There is no existing ocean site for this material, and federal and state agencies are demanding ocean site investigations that are off of the continental shelf, prior to new ocean site designation.

The beneficial reuse of dredged material to create, restore or enhance wetlands would reduce a portion of the current in-bay disposal requirements and its associated impacts. Currently, there are several dredged material beneficial reuse projects existing or in the design stage. Several projects in the design phase would use dredged sediment to create, restore, or enhance wetlands. There is a high potential for restoration or enhancement opportunities in former wetland areas which have diked, drained and used for agricultural purposes. However, there are currently no sediment screening criteria or testing requirements for wetlands construction projects using dredged sediment.

1.2 Purpose and Scope

This document provides sediment screening criteria and testing requirements for the beneficial reuse of dredged material such as wetlands creation and upland disposal of dredged material. This document is intended to facilitate creation, enhancement and restoration of wetlands. As such the Regional Board will not apply the screening criteria without consideration of site-specific factors.

This includes dredged sediment screening criteria for determining acceptable concentrations of constituents in dredged sediment for beneficial reuse purposes and dredged sediment testing requirements for applying the sediment screening criteria.

Wetlands creation, restoration, or enhancement is considered aquatic disposal of dredged sediment under the Clean Water Act Section 404 and thus is regulated by the State and Regional Boards under Section 401 of the Clean Water Act. Upland disposal of dredged sediment includes disposal options such as landfill cover material, levee restoration and other related nonaquatic projects. In general, the discharge of dredged sediment in the nonaquatic environment is regulated by California Code of Regulations Title 23, Chapter 15.

Section 2 of this document discusses the approach taken in developing the sediment screening criteria. Section 3 discusses the requirements of the California Code of Regulations with respect to discharges of waste to land and the relationship to dredged sediment. Section 4 discusses regional sediment concentrations. The sediment screening criteria are selected in Section 5. Section 6 describes the testing requirements for the wetlands and nonaquatic disposal options.

2.0 Approach

The general approach used in developing sediment screening criteria and testing requirements is based on the document General Decisionmaking Framework for Management of Dredged Material: Example Application to Commencement Bay, Washington, (Lee et al., 1991). This document provides a decisionmaking framework for selecting the appropriate dredged sediment testing requirements based on the disposal options considered and provides a process to evaluate the test results.

Some wetlands creation projects may accept smaller amounts of dredged material from many different dredging projects. These "multi-user" wetland projects may be accepting the cumulative quantity of a large project.

Lee et al. (1991) sets out the five following different tests that should be conducted to determine the acceptability of disposal of dredged sediment in an upland area. The associated pathway of pollutant mobility each test is designed to assess is also listed.

	<u>Test</u>	<u>Pathway of Contaminant Mobility</u>
1.	Effluent Quality	Effluent Discharge
2.	Surface Runoff Quality	Runoff
3.	Leachate Quality	Leachate Seepage Soluble Diffusion, Seepage Soluble Convection Via Tidal Pumping Capillary Action Mobility Between Layers
4.	Plant Uptake	Bioturbation (Uptake through roots)
5.	Animal Uptake	Bioturbation (Uptake through soil consumption or contact)

Figure 1 depicts the pathways that would occur in a wetland environment. These pathways are a combination of upland and aquatic pathways.

The approach also involved reviewing the pertinent section of the California Code of Regulations to determine a classification scheme for dredged sediment. San Francisco Bay wetlands sediment background concentrations were then reviewed to establish a range of concentrations levels for comparison to potential sources of dredged

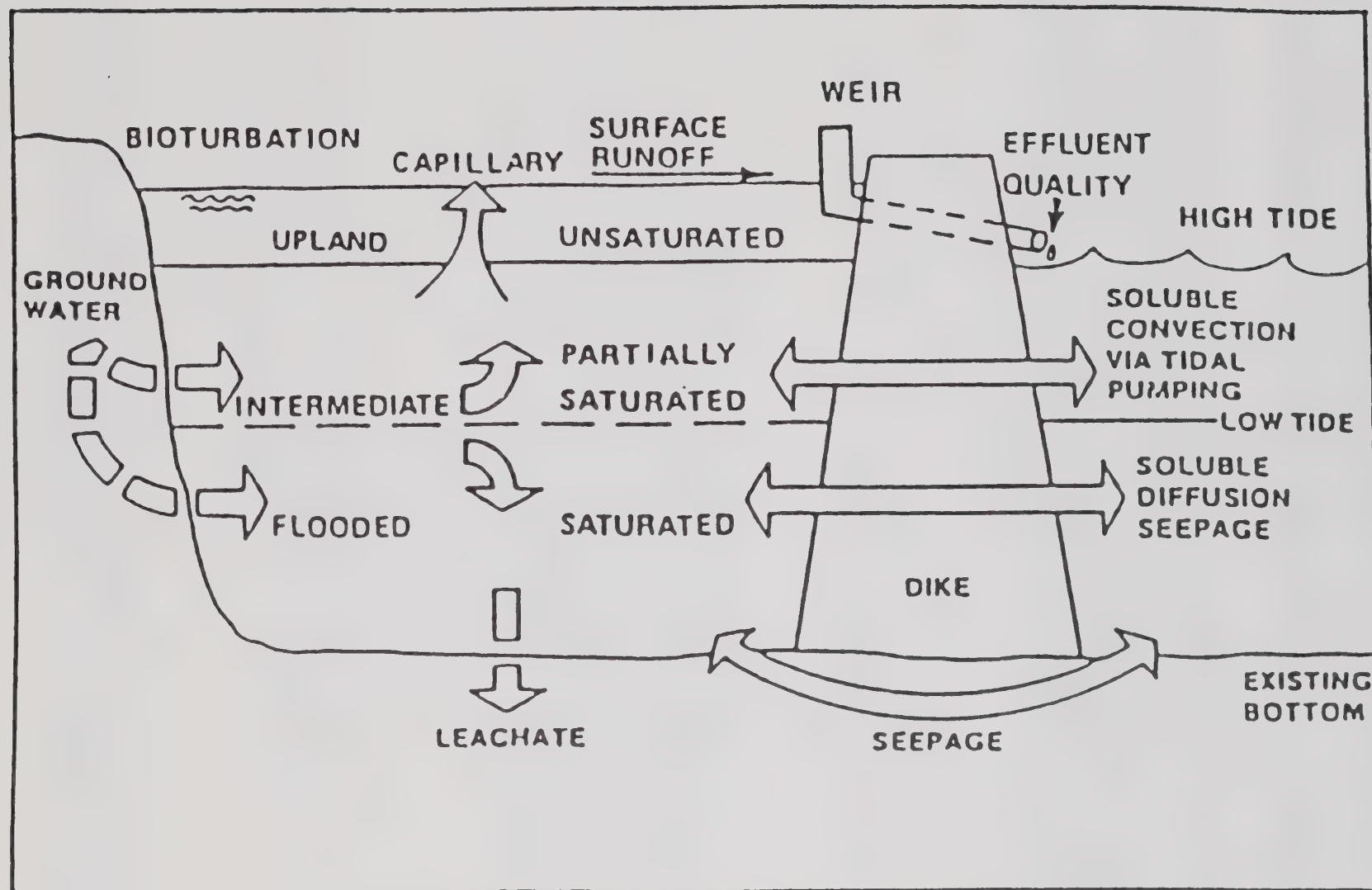


Figure 1 - Restored Wetland Contaminant Mobility Pathways (Lee et al., 1991)

sediment. Sediment toxicity literature was then reviewed to determine how regional sediment concentrations compare to sediment toxicity values. Wetlands sediment background concentrations and sediment toxicity values and associated chemical concentrations were then used to establish sediment screening criteria which should eliminate aquatic impacts of dredged sediment disposal through the beneficial reuse of dredged sediment.

Sediment screening criteria are defined in the context of this report as the maximum concentrations of constituents in dredged sediment acceptable for the designated use. Any exceedance of the sediment screening criteria will be reviewed on a case-by-case basis due to the inherent uncertainty in establishing sediment screening criteria. As the results of the more detailed project specific testing is published, these data will be compared to the sediment screening criteria and modifications may be made as appropriate.

3.0 Dredged Material Disposal Options Relationship to Title 23, Chapter 15

Dredged sediment disposal to land restrictions are based on the concentration of certain constituents in the dredged sediment and on site-specific conditions. The disposal of waste material to land is regulated by the California Code of Regulations, Title 23 (Waters), Division 3 (State Water Resources Control Board), Chapter 15 (Discharges of Waste to Land). In Chapter 15, wastes are separated into four different categories; hazardous waste, designated waste, nonhazardous solid waste, and inert waste. Each different category of waste has different disposal requirements. Hazardous waste must be disposed of at a Class I waste management unit, designated waste must be disposed of at a Class I or II waste management unit, nonhazardous solid waste may be disposed of at a Class III landfill, and inert waste does not have to be disposed of at a classified waste management unit.

3.1 Waste Descriptions

Chapter 15 contains descriptions of the four different waste categories which are summarized below.

3.1.1 Hazardous Waste

The description of hazardous waste is referenced to Title 22, Division 4.5, Chapter 11, Article 3. Article 3 contains specific concentrations for certain hazardous waste constituents as shown in Table 1. A waste is hazardous if it has constituents (hazardous waste constituents) in excess of specified concentrations. Hazardous waste constituents have been established for a relatively few constituents. Other constituents must be assessed based on toxicity, reactivity, flammability and corrosivity. Chapter 15 does not contain numerical concentration values for designated waste, nonhazardous solid waste or inert waste but does have narrative criteria to differentiate the type of wastes, as described below.

3.1.2 Designated Waste

Designated waste is nonhazardous waste which consists of or contains pollutants which, under ambient environmental conditions at the waste management unit, could be released at concentrations in excess of applicable water quality objectives, or which could cause degradation of waters of the state.

3.1.3 Nonhazardous Solid Waste

Nonhazardous solid waste is all putrescible (decomposable) and nonputrescible solid, semi-solid and liquid wastes, including garbage and trash, refuse, paper, rubbish, ashes, industrial wastes, demolition and construction wastes, abandoned vehicles,

discarded home and industrial appliances, manure, vegetable or animal solid and semi-solid wastes and other discarded solid or semi-solid wastes; provided that such wastes are not hazardous or designated wastes.

3.1.4 Inert Waste

Inert waste is waste that does not contain hazardous waste or soluble pollutants at concentrations in excess of applicable water quality objectives, and does not contain significant quantities of decomposable waste.

3.1.5 Treated Sediment

Dredged sediments may be treated prior to disposal in order to meet disposal or reuse contaminant criteria. Dredgers may use a variety of treatment methods, including chemical fixation of inorganic contaminants and biodegradation of petroleum hydrocarbons, provided that the treatment methods employed have been demonstrated to be effective for a particular sediment. Such demonstration studies typically are based on the results of leachate testing and modeling.

3.2 Waste Management Units Requirements

The three different classes of waste management units (landfills) are defined in Chapter 15 based on their ability to isolate wastes from waters of the state. Inert waste does not have to be disposed of at a classified waste management unit. Class III landfills shall be located where soil characteristics, distance from waste to groundwater, and other factors will ensure no impairment of beneficial uses of surface water or of groundwater beneath or adjacent to the landfill. Class II units must be underlain by natural geologic materials which have a permeability of not more than 1×10^{-6} cm/sec and which are of sufficient thickness to prevent vertical movement of fluid from waste management units to waters of the state as long as wastes in such units pose a threat to water quality. Class I units must be underlain by natural geologic materials which have a permeability of not more than 1×10^{-7} cm/sec and which are of sufficient thickness to prevent vertical movement of fluid from waste management units to waters of the state as long as wastes in such units pose a threat to water quality.

4.0 Regional Sediment Concentrations

Because no numerical standards exist for the definition of designated, nonhazardous or inert waste, sediment data from several different sources throughout the country were compiled as shown in Table 1 to assist in categorizing sediments with respect to Chapter 15 narrative criteria.

4.1 United States Geological Survey

Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States, U. S. Geological Survey (USGS) Professional Paper 1270, (Shacklette and Boerngen, 1984) presents concentrations of elements in soil collected at 1,318 sampling sites throughout the country. This report establishes nationwide background soil concentrations. Sediments in this range would generally be classified as inert waste. Western, eastern and the conterminous United States data are presented. The western and eastern portions of the country are separated by an area that runs from western Minnesota through east-central Texas. The paper presents arithmetic and geometric means and ranges for 50 different elements. Concentrations from the USGS report of priority pollutant metals commonly found in dredged sediment are presented in Table 1. Western United States values (e.g. mercury, selenium, and boron) are generally greater than the conterminous United States values.

4.2 National Oceanic and Atmospheric Administration

San Francisco Bay Basin mean sediment concentrations from the report Status and Trends in Concentrations of Contaminants and Measures of Biological Stress in San Francisco Bay, National Oceanic and Atmospheric Administration (NOAA) Technical Memorandum NOS OMA 41 are presented in Table 1 (Long et al., 1988). This report compiled sediment data collected by many different authors from San Francisco Bay from the 1970's and 1980's. In this report, San Francisco Bay includes Suisun Bay/Carquinez Strait, San Pablo Bay, Central Bay and South San Francisco Bay. The report refers to areas such as Mare Island Strait, Richmond Harbor Channel, Oakland Inner and Outer Harbor, Islais Creek Waterway, China Basin, and Redwood Creek as "periphery" areas, and data from these areas are not included in the data set presented in Table 1.

Table 1 also contains Effects Range-Low (ER-L) and Effects Range-Median (ER-M) sediment concentrations from the report The Potential for Biological Effects of Sediment-Sorbed Contaminants in the National Status and Trends Program, National Oceanic and Atmospheric Administration (NOAA) Technical Memorandum NOS OMA 52, (Long et al., 1990). The Long et al. (1990) report contains a compilation of different sediment toxicity evaluation reports which followed four different approaches: equilibrium-partitioning approach, spiked-sediment bioassay approach, apparent effects approach, and the co-occurrence analysis of field data approach. The sediment

Table 1
Sediment Concentrations for the United States and the San Francisco Bay Area;
and Surface Water Quality Criteria and Hazardous Waste Concentrations

Constituent	Western United States Mean ¹ (Range in parens.)	Conterminous United States Mean ¹ (Range in parens.)	SF Bay Basins Mean ² (No. of samples, first parens.; range, second parens.)	NOAA ³ Effects Range-low / Effects Range-median	USACOE Bay Area Marsh Study Mean ⁴ (Range in parens.)	SFB-RWQCB ⁵ Marine Water Quality Objectives	Title 22, Section 66261.24 Hazardous Waste Concentration(TTLC, Wet-Weight)
Cadmium	N/A	N/A	0.94 (256) (0.02-17.3)	5.0 / 9.0	0.34 (0.14-0.56)	0.0093	100
Chromium	56 (3-2,000)	54 (1-2000)	108 (140) (9-769)	80.0 / 145.0	181 (110-224)	0.050	500
Copper	27 (2-300)	25 (<1-700)	36 (376) (3-145)	70.0 / 390.0	90.6 (24.2-90.6)	0.0029	2,500
Lead	20 (<10-700)	19 (<10-700)	32 (461) (1-421)	35.0 / 110.0	35.4 (13.7-85.6)	0.0056	1,000
Mercury	0.065 (<0.01-4.6)	0.089 (<0.01-4.6)	0.45 (396) (<0.01-6.60)	0.15 / 1.3	0.33 (0.059-0.515)	0.025x10 ⁻³	20
Nickel	19 (<5-700)	19 (<5-700)	N/A	30 / 50	105.4 (32.2-145.2)	0.0083	2,000
Silver	N/A	N/A	0.51 (148) (0.01-2.4)	1.0 / 2.2	N/A	0.0023	500

Constituent	Western United States Mean ¹ (Range in parens.)	Contermin-uous United States Mean ¹ (Range in parens.)	SF Bay Basins Mean ² (No. of samples, first parens.; range, second parens.)	NOAA ³ Effects Range-low / Effects Range-median	USACOE Bay Area Marsh Study Mean ⁴ (Range in parens.)	SFB-RWQCB ⁵ Marine Water Quality Objectives	Title 22, Section 66261.24 Hazardous Waste Concentration(TTLC, Wet-Weight)
Selenium	0.34 (<0.1-94.3)	0.39 (<0.1-4.3)	N/A	N/A	0.32 (<0.14-0.91)	0.071	100
Zinc	65 (10-2,100)	60 (<5-2900)	N/A	120 / 270	143.3 (88.5-166.1)	0.086	5,000
Nonmetals							
Arsenic	7.0 (<0.01-97)	7.2 (<0.01-97)	N/A	33.0 / 85.0	14.8 (5.29-23.7)	0.036	500
PCBs			0.045 (37) (0.006-0.14)	0.050 / 0.40		0.070x10 ⁻⁶	50
Pesticides							
Total DDT			0.009 (75) (0.00025-91)	0.003 / 0.35		0.6x10 ⁻⁶	1.0
DDT				0.001 / 0.007			1.0
DDE				0.002 / 0.015			1.0

Constituent	Western United States Mean ¹ (Range in parens.)	Conterminous United States Mean ¹ (Range in parens.)	SF Bay Basins Mean ² (No. of samples, first parens.; range, second parens.)	NOAA ³ Effects Range-low / Effects Range-median	USACOE Bay Area Marsh Study Mean ⁴ (Range in parens.)	SFB-RWQCB ⁵ Marine Water Quality Objectives	Title 22, Section 66261.24 Hazardous Waste Concentration(TTLC, Wet-Weight)
DDD				0.002 / 0.020			1.0
Other Pesticides							
Chlordane				0.0005 /0.006		0.081x10 ⁻⁶	2.5
Dieldrin				0.00002 / 0.008		0.14x10 ⁻⁶	8.0
Endrin				0.00002 / 0.045		0.0023x10 ⁻³	0.2
Polynuclear Aromatic Hydrocarbons (PAH)							
Acenaphthene				0.150 / 0.650			
Anthracene				0.085 / 0.960			

Constituent	Western United States Mean ¹ (Range in parens.)	Conterminuous United States Mean ¹ (Range in parens.)	SF Bay Basins Mean ² (No. of samples, first parens.; range, second parens.)	NOAA ³ Effects Range-low / Effects Range-median	USACOE Bay Area Marsh Study Mean ⁴ (Range in parens.)	SFB-RWQCB ⁵ Marine Water Quality Objectives	Title 22, Section 66261.24 Hazardous Waste Concentration(TTLC, Wet-Weight)
Benzo(a)-anthracene				0.230 / 1.600			
Benzo(a)-pyrene				0.400 / 2.500			
Benzo(e)-pyrene				NA			
Biphenyl				NA			
Chrysene				0.400 / 2.800			
Dibenz(a,h)-anthracene				0.060 / 0.260			
2,6-dimethylnaphthylene				NA			
Fluoranthene				0.600 / 3.600			
Fluorene				0.035 / 0.640			
1-methylnaphthalene				NA			

Constituent	Western United States Mean ¹ (Range in parens.)	Conterminous United States Mean ¹ (Range in parens.)	SF Bay Basins Mean ² (No. of samples, first parens.; range, second parens.)	NOAA ³ Effects Range-low / Effects Range-median	USACOE Bay Area Marsh Study Mean ⁴ (Range in parens.)	SFB-RWQCB ⁵ Marine Water Quality Objectives	Title 22, Section 66261.24 Hazardous Waste Concentration(TTLC, Wet-Weight)
2-methyl-naphtha-lene				0.065 / 0.670			
1-methyl-phenan-threne				NA			
Naphtha-lene				0.340 / 2.100			
Perylene				NA			
Phenan-threne				0.225 / 1.380			
Pyrene				0.350 / 2.200			
2,3,5-tri-methyl-naphtha-lene				NA			
Total PAH			4.1 (101) (0.02-80.9)	4.0 / 35.0		0.031x10 ⁻³	

All sediment units are mg/kg, dry weight, except the TTLC's, which are wet weight.
Water quality units are mg/l.

Footnotes:

- 1. Shacklette and Boerngen, (1984)**
- 2. Long et al. (1988)**
- 3. Long et al. (1990)**
- 4. Lee et al. (1992)**
- 5. SFBRWQCB, (1992)**

toxicity results of all the different studies were ranked for each individual parameter, and the lower 10 percentile toxicity value in the data was identified as the ER-L and the median toxicity value was identified as the ER-M. The ER-L is the chemical concentration above which adverse biological effects may be expected 10% of the time. The ER-M is the chemical concentration above which adverse biological effects may be expected 50% of the time. Adverse biological effects include mortality or sublethal effects (e.g. reduced growth or reproduction success).

4.3 United States Army Corps of Engineers

The United States Army Corps of Engineers (COE) conducted a study of wetlands in the San Francisco Bay Area that were in nondeveloped areas away from potential source areas in order to compare wetlands creation using dredged material to natural wetland areas. These data are published in the report Evaluation of Wetland Creation with J. F. Baldwin Ship Channel Sediment (Lee et al. 1992). Table 1 contains the averages and ranges of the metals analyses from the natural wetlands.

4.4 Marine Water Quality Objectives

The San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) marine water quality objectives are the water quality concentrations that should be attained in a marine water body to protect aquatic resources (SFBRWQCB, 1992). These values are provided in Table 1 for comparison purposes to the sediment concentrations.

4.5 Title 22, Section 66261.24 Hazardous Waste Concentrations

The Title 22, Section 66261.24 Hazardous Waste Concentrations are referred to as the Total Threshold Limit Concentration (TTLC) and are the total concentration of the constituents in the waste such that at concentrations greater than the TTLC the waste is considered hazardous and must be disposed of at a Class I waste management unit. A waste is also defined as hazardous if the concentration of a constituent in its extract is greater than the soluble limit threshold concentration (STLC), as defined in Section 66261.24. A waste is also considered hazardous if it exhibits toxicity to test organisms in a bioassay at a concentration of 500 mg/l.

5.0 Sediment Screening Criteria

Sediment screening criteria have been included for different categories of disposal options including Class I, II and III landfills, and wetlands creation cover and noncover material. In order to facilitate the determination of the waste classification and associated disposal options for dredged material, sediment screening criteria for each disposal option are proposed in Table 2.

These values are sediment screening criteria in that these values will be the initial values that any dredged sediment project proponent will have to compare the quality of its dredged sediment to in order to determine the appropriate disposal option. The project proponent will also compare the results of their biological testing for the wetlands creation cover material option to the appropriate reference results. The results of the chemical and biological testing together will determine the appropriate disposal location.

Four disposal options are presented in Table 2 and each is described below.

5.1 Wetlands Creation Cover

Dredged sediment with chemical concentrations less than the chemical concentrations listed in this column is acceptable for potential use in all wetlands creation projects at any depth within the wetland. Further testing is necessary to determine the suitability as described in Section 6. Dredged material below these concentrations is also acceptable for levee restoration and maintenance, landfill daily cover, and upland building material.

5.2 Wetlands Creation Noncover or Class III Landfill

Dredged material with sediment concentrations within the ranges listed in this column is acceptable for wetlands creation noncover material as long as there is a minimum 3 feet of wetlands creation cover material or native material on the top and sides of the noncover material. For tidal wetland systems, a greater lateral distance may be necessary due to tidal fluctuations. This material or sediment will be referred to as noncover material. This material will be isolated by the cover material from exposure to biological communities (Figure 2).

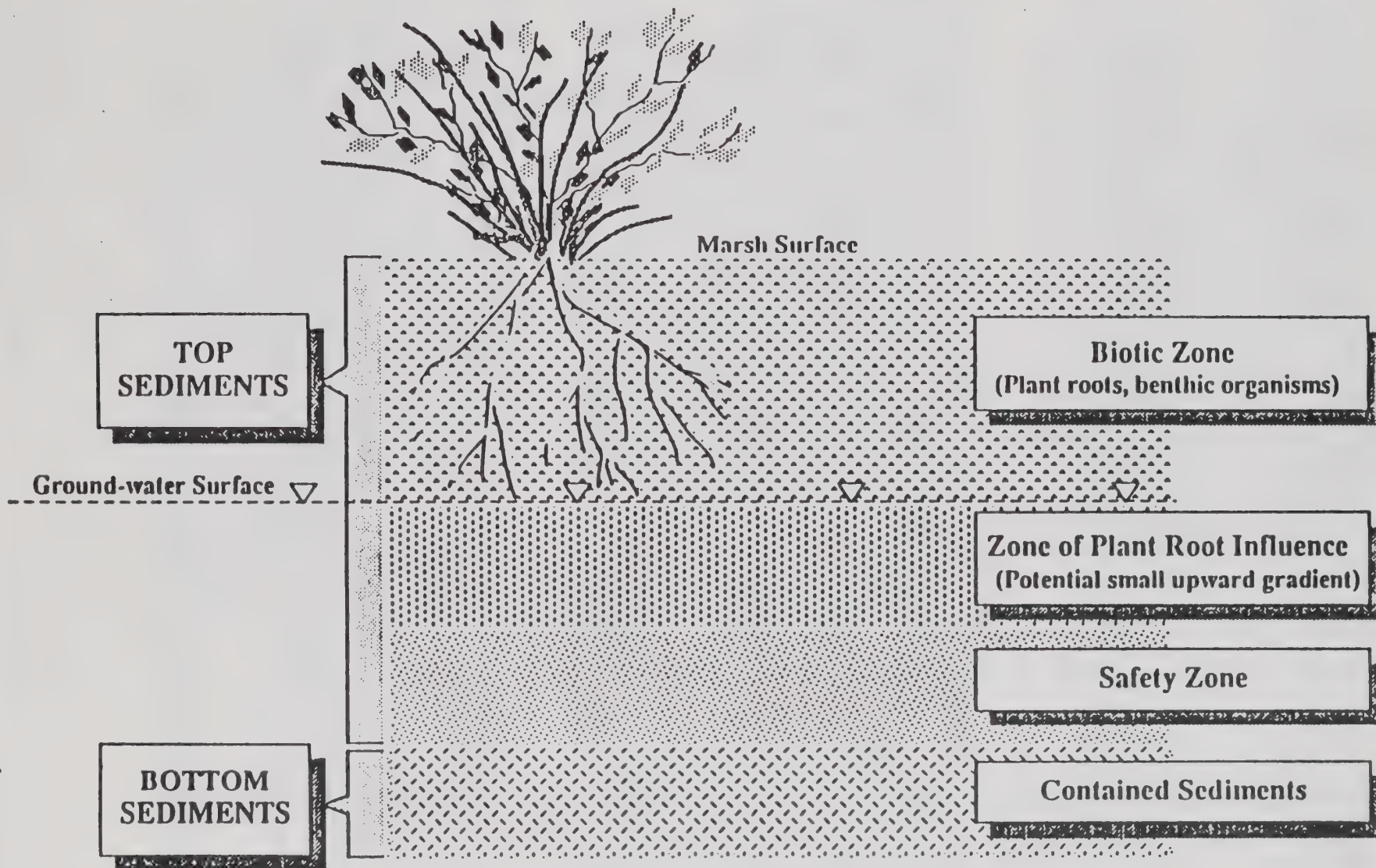
A distinct hydrogeological separation should exist between the first-encountered shallow groundwater aquifer and any local deeper drinking water aquifers. If a distinct hydrogeological separation does not exist, a 1 to 3 foot layer of cover material is required to be placed beneath the noncover material, and the use of the noncover material in these situations will be evaluated on a case-by-case basis.

Table 2
Disposal Option
Sediment Screening Criteria

Constituent	Class I ¹	Class II or III	Wetlands Creation Noncover	Wetlands Creation Cover, Levee Restoration, Landfill Daily Cover
Metals				
Cadmium	>200	DETERMINED	9 - 5	<5
Chromium	>1000	BY SITE-	300 - 220	<220
Copper	>5,000	SPECIFIC	390 - 90	<90
Lead	>2,000	CONDITIONS	110 - 50	<50
Mercury	>40		1.3 - 0.35	<0.35
Nickel	>4,000		200 - 140	<140
Silver	>1,000		2.2 - 1.0	<1.0
Selenium	>200		1.4 - 0.7	<0.7
Zinc	>10,000		270 - 160	<160
Nonmetals				
Arsenic	>1,000		85 - 33	<33
PCBs	>100		0.4 - 0.05	<0.05
Pesticides				
Total DDT	>2.0		0.1 - 0.003	<0.003
Total PAH	N/A		35 - 4	<4

All units are mg/kg.

Footnotes 1. Title 22, Division 4.5, Chapter 11, Article 3, Section 66261.24; Section 66261.24 lists concentrations in wet weight; this table lists dry weight value assuming dredged material at 50% solids.



June 12, 1991

CONCEPTUAL PROFILE OF RESTORED WETLANDS SHOWING RELATIONSHIP TO CONTAINED SEDIMENTS

Figure 2 (From Levine-Fricke, 1991)

5.3 Class II or III Landfill

Dredged material with sediment concentrations within the ranges listed in this column should be evaluated for disposal at a Class II or III landfill. Requirements of the individual landfill would have to be followed. It is not the intent of this document to dictate to landfills what concentrations of material should be accepted.

5.4 Class I Landfill

Dredged material with sediment concentrations above the levels listed in this column must be disposed of at Class I landfill. Requirements of the individual landfill would have to be followed. It is not the intent of this document to dictate to landfills what concentrations of material should be accepted.

5.5 Sediment Screening Criteria Rationale

The Long et al. (1990) ER-L and ER-M values were compared to dredged material values typically found in the Bay Area (Long et al., 1988; and other dredging projects) and to sediment samples from around the Bay Area (Lee et al., 1992; Long et al., 1990; Shacklette and Boerngen, 1984). The wetlands creation cover material screening criteria were selected based on the greater of the ER-L or the upper range of the natural wetlands concentrations from Lee et al. (1992), but if the upper range metal value from Lee et al. (1992) was greater than the 20th percentile value value from Long et al. (1990), then the 20th percentile value was selected. Chromium, nickel and selenium are exceptions with further discussion in the sections below.

The ER-L, or 10th percentile value from Long et al. (1990), is the chemical concentration above which adverse biological effects may be expected 10% of the time. Up to the 20th percentile value was considered appropriate for the screening criteria based on the values detected in natural wetlands throughout the Bay Area.

The ER-M value was considered the upper value for acceptance of wetlands creation noncover material for all constituents. The ER-M is the chemical concentration above which adverse biological effects may be expected 50% of the time. This value was considered protective for noncover material since there will be three feet of wetlands creation cover material over top of the noncover material. Three feet of cover material should provide adequate distance to insulate benthic organisms and plant roots from the noncover material. Chromium and nickel are the only two constituents whose level was set above the ER-M for the wetlands creation noncover material sediment screening criteria due to the high natural background concentrations of chromium and nickel in the Bay Area. The total DDT value was set below the ER-M.

The following sections provide the specific rationale for the chromium, nickel, selenium, and DDT sediment screening criteria.

5.5.1 Chromium

The following data are available for chromium, all units are mg/kg, dry weight:

ER-L (Long et al. 1990)	80
ER-M (Long et al. 1990)	145
SF Bay Basins Mean (Long et al. 1988)	108
Western United States Mean (Shacklette and Boerngen 1984)	56
Bodega Bay two year average (Long et al. 1990)	349.7
Tomales Bay two year average (Long et al. 1990)	218
Dumbarton Bridge two year average (Long et al. 1990)	170
San Mateo Bridge two year average (Long et al. 1990)	167.5
San Pablo Bay two year average (Long et al. 1990)	185
Upper range, natural wetland (Lee et al. 1992)	224

The above information indicates the background concentration of chromium in Bay Area sediments is naturally higher than the western United States mean. The Shacklette and Boerngen, (1984) nationwide distribution map for chromium shows that chromium sediment concentrations in northern California are higher than the western United States mean. In particular, Bodega Bay and Tomales Bay, are 6.2 and 3.9 times greater than the western United States mean for chromium. The data from San Francisco Bay showed no consistent pattern of toxicity for the values cited above and thus were excluded from the calculation of the ER-L and ER-M. Preliminary Apparent Effects Threshold values based solely on San Francisco Bay data established levels of 280 mg/kg and 370 mg/kg for chromium for the bivalve larvae and amphipod bioassay respectively (SWRCB 1990). Based on the above information a value of 220 mg/kg is selected as the sediment screening criteria for wetlands cover material and 300 mg/kg for wetlands noncover material. 220 mg/kg and 300 mg/kg are approximately the 78th and 87th percentile values, respectively, for chromium from Long et al. (1990).

5.5.2 Nickel

The following data are available for nickel, all units are mg/kg, dry weight:

ER-L (Long et al. 1990)	30
ER-M (Long et al. 1990)	50
SF Bay Basins Mean (Long et al. (1988)	No Data
Western United States Mean (Shacklette and Boerngen 1984)	19
Bodega Bay two year average (Long et al. 1990)	54.8
Tomales Bay two year average (Long et al. 1990)	166.7
Dumbarton Bridge two year average (Long et al. 1990)	90.8
San Mateo Bridge two year average (Long et al. 1990)	112.5
San Pablo Bay two year average (Long et al. 1990)	87.8
Upper range, natural wetland (Lee et al. (1992)	145.2

The above information indicates the background concentration of nickel in Bay Area sediments is naturally higher than the western United States mean. The Shacklette and Boerngen, (1984) nationwide distribution map for nickel shows that nickel sediment concentrations in northern California are higher than the western United States mean. In particular, Bodega Bay and Tomales Bay, two nondeveloped areas, are 2.9 and 8.8 times greater than the western United States mean for nickel. Again, no San Francisco Bay data was used in the calculation of the ER-L and ER-M. Preliminary Apparent Effects Threshold values based solely on San Francisco Bay data established a level of greater than 170 mg/kg for nickel for the bivalve larvae and amphipod bioassay respectively (SWRCB 1990). Based on the above information a value of 140 mg/kg is selected as the sediment screening criteria for wetlands cover material and 200 mg/kg for wetlands noncover material. 140 mg/kg and 200 mg/kg are approximately the 95th and 96th percentile values, respectively, for nickel from Long et al. (1990).

5.5.3 Selenium

The western United States mean selenium sediment concentration from Shacklette and Boerngen, (1984) is 0.34 mg/kg. The Long et al. (1988) and Long et al. (1990) reports did not include selenium. Selenium concentrations in Bay Area dredged material is typically in the 0.2 mg/kg to 1.5 mg/kg range. The upper range for natural wetlands found in Lee et al. (1992) was 0.91 mg/kg. Absent of any further information, a value of two times the western United States mean, or 0.7 mg/kg, is selected as the sediment screening criteria for wetlands cover material and a value of four times the western United States mean, or 1.4 mg/kg, is selected as the sediment screening criteria for wetlands noncover material.

5.5.4 Total DDT

The ER-M for Total DDT is 0.35 mg/kg. However the ER-M for DDT, DDE, and DDD are 0.007 mg/kg, 0.015 mg/kg, and 0.02 mg/kg, respectively. Given the relative difference between the ER-Ms of the total and individual DDTs, a conservative screening criteria of 0.1 mg/kg for total DDT including all of the isomers was selected for wetlands noncover material. The ER-L of 0.003 mg/kg was selected for the wetlands cover material screening criteria.

Figure 4
Uplands or Wetlands Disposal Options
Decision Flow Chart

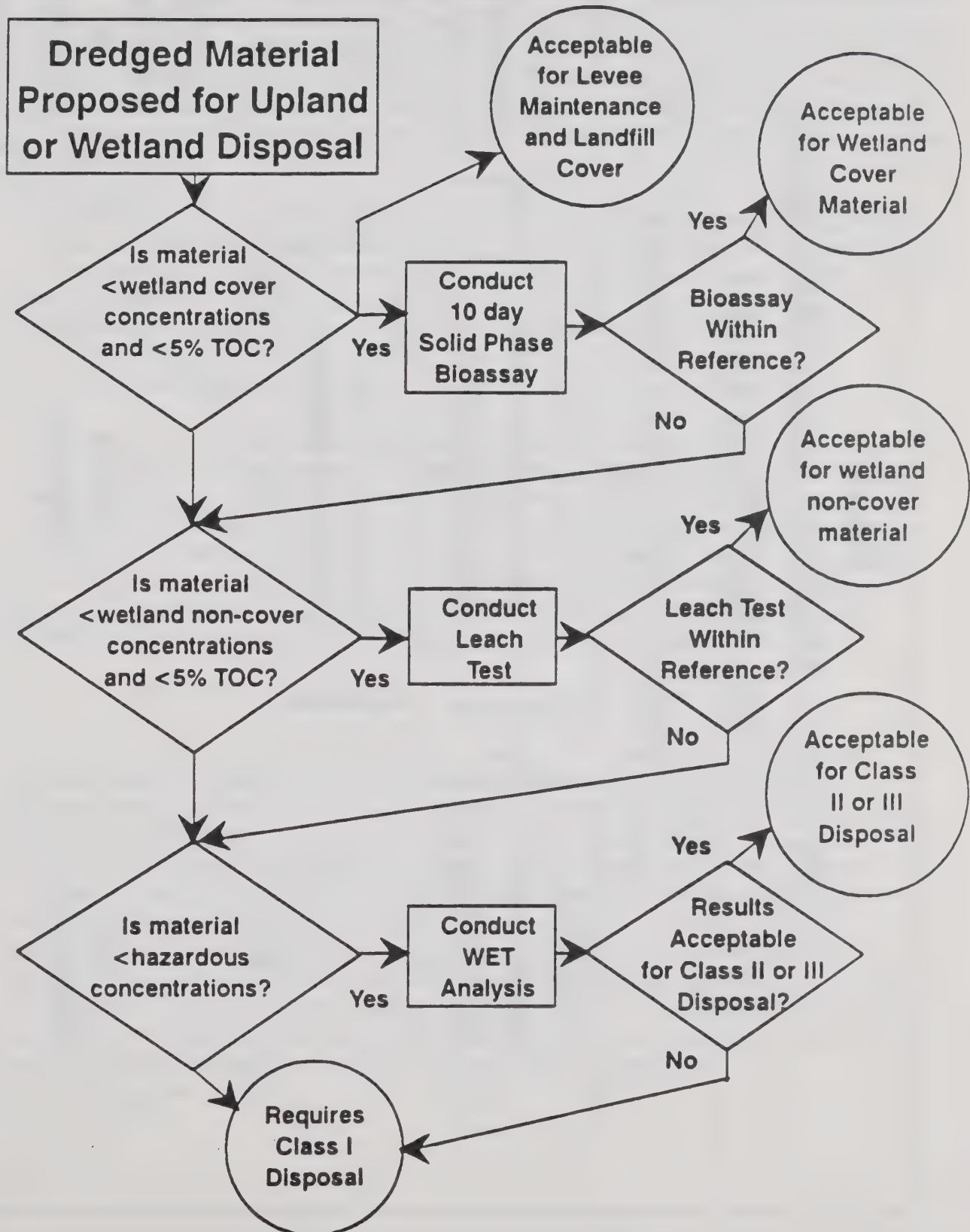
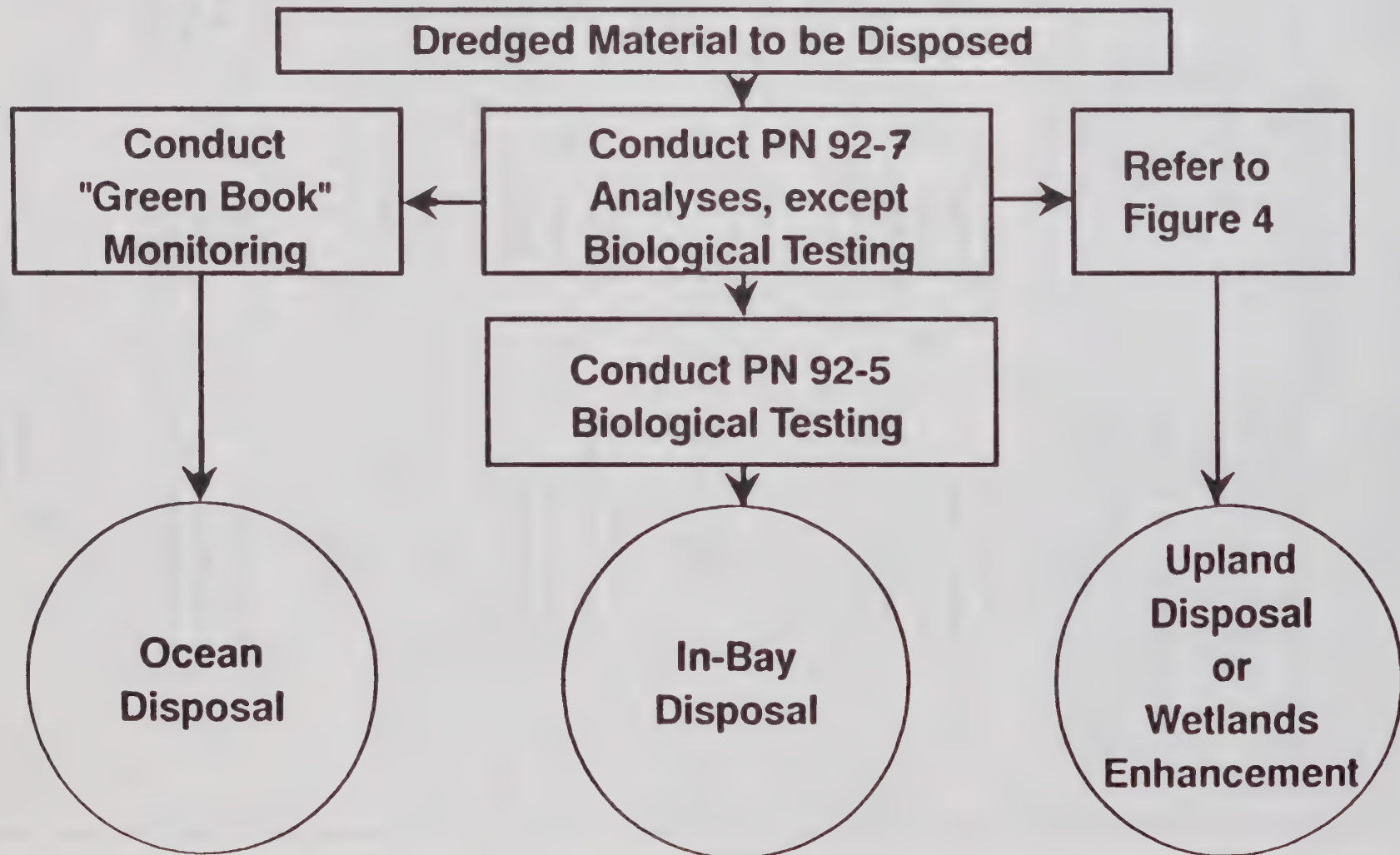


Figure 3
Dredged Material Disposal Option
Decision Flow Chart



6.0 Disposal Option Testing Requirements

Each different disposal option has dredged material testing requirements specific to the final disposal location. Certain testing requirements are common to all disposal options. For wetlands creation and upland disposal, all dredging projects are required to complete the testing requirements contained in Public Notice 92-7, Interim Testing Procedures for Evaluating Dredged Material Disposal in San Francisco Bay (USACOE/USEPA/ SFBRWQCB/BCDC 1992), except for the biological testing. Based on the results of this testing the dredged material analyses, the project may be preliminarily proposed for the appropriate disposal option based on the sediment screening criteria in Table 2.

The following additional testing requirements are specific to the individual disposal options. The results of the additional testing shall be compared to the individual test reference results in order to determine if it is acceptable to use the dredged material for the specific use. Figures 3 and 4 contain flow chart diagrams depicting the sediment concentrations and testing requirements for each disposal option.

6.1 Wetlands Creation Cover

Dredging projects proposed for wetlands creation cover material shall also complete a 10 day solid phase bioassay test (ASTM 1990). Reference sediment will be sediment from an existing wetland in the vicinity of the proposed wetland. In addition a modified leach test using surface waters from the area to be created should also be conducted. The leach test required will be a modified Waste Extraction Test (WET) Procedure described in Title 22, Division 4.5, Chapter 11, Appendix II. Dredged material proposed for levee restoration, landfill daily cover, or upland building material do not have to conduct a 10 day solid phase bioassay.

6.2 Wetlands Creation Noncover

Dredging projects proposed for wetlands creation noncover material shall also complete a leach test on the dredged material. The extraction solution should be surface water from the area where the wetlands will be created. The net extractable concentration should be less than the net extractable concentration from a leach test completed on soil from an adjacent wetland in the area of the proposed wetland and shall not exceed background concentrations in local groundwater. Additionally, the leachate will be evaluated against applicable water quality criteria values for constituents of concern. This leach test will compare the amount of soluble pollutants that would naturally leach out of upland sediments, that may at some time in the future become source areas for natural wetlands creation, versus that which will leach out of the dredged material. The leach test employed should include procedures for leachate extraction under reduced as well as oxidized conditions.

6.3 Class III Landfill

Dredged material proposed for disposal at a Class III landfill will ultimately have to meet the testing requirements and sediment screening criteria of the individual landfill. One testing procedure that the SFBRWQCB staff has accepted (SFBRWQCB, 1991) is the CVRWQCB staff "Designated Level Methodology" (Marshak, 1989) to determine if a material is acceptable for disposal at a Class III landfill. This methodology involves running the Waste Extraction Test on a material and multiplying the extractable concentration from the material by an attenuation factor, then comparing this result to the appropriate water quality objective. The attenuation factor accounts for the depth of sediment between groundwater and the landfill. This procedure is site specific and material specific hence criteria are determined on as needed basis by the landfill operator with concurrence by the Regional Board.

6.4 Class II Landfill

Dredged material proposed for disposal at a Class II landfill will ultimately have to meet the testing requirements and sediment screening criteria of the individual landfill. In general if a material fails to be accepted at a Class III landfill and is below the concentrations of a hazardous waste, it is acceptable to be disposed of at a Class II landfill.

6.5 Class I Landfill

Dredged material proposed for disposal at a Class I landfill will ultimately have to meet the testing requirements and sediment screening criteria of the individual landfill. In general if a material contains greater concentrations greater than those listed in Title 22, Section 66261.24, then the material is hazardous and must be disposed of at a Class I facility.

6.6 Definition of Dredged Material as Inert Waste With Respect to Chapter 15

Dredged material will be considered inert waste if the following criteria are met:

1. It has concentrations less than those listed for wetlands creation cover material and it passes the 10 day solid-phase bioassay test;
- or
2. It is within the concentrations for the wetlands noncover material and it passes the leach test.

If dredged material meets the above criteria it is considered to be inert waste under ambient conditions because it does not contain hazardous waste or soluble pollutants at concentrations in excess of applicable water quality objectives, and does not contain

significant quantities of decomposable waste.

REFERENCES

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STATE OF CALIFORNIA
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

EXECUTIVE OFFICER SUMMARY REPORT
MEETING DATE: NOVEMBER 18, 1992

ITEM: 10

SUBJECT: SEDIMENT SCREENING CRITERIA AND TESTING
REQUIREMENTS FOR WETLAND CREATION AND UPLAND
BENEFICIAL REUSE - Hearing to Receive Testimony and
Consider Adoption of Guidelines

CHRONOLOGY: The Regional Board heard testimony on this item on October 21,
1992.

DISCUSSION: The guidance document entitled: Sediment Screening Criteria and
Testing Requirements for Wetlands Creation and Upland
Beneficial Reuse was considered at the October Board meeting.
The item was continued to the November meeting so that staff
could responded to comments. A draft of the Screening Criteria
was circulated to interested parties on September 18, 1992. Staff
received ten comment letters from industry and environmentalists
addressing various aspects of the document, ranging from the
typographical errors to major policy issues. The Screening Criteria
document has been changed to reflect some of the comments
received and a Response to Comments has been prepared (Exhibit
D) .

Staff feel that the Screening Criteria document reflects the
concerns of the general public and the regulated community. It
should prove to be a useful tool in regulating and facilitating
wetland creation and beneficial reuse of dredged material. The
Screening Criteria is intended to be an interim document and will
complement some of the work underway through the LTMS.

RECOMMEND-
DATION: I will make a recommendation at the Board meeting.

File No. 1535.05

Appendices: A: Tentative Resolution
B: Sediment Screening Criteria
C: Correspondence
D: Response to Comments

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

RESOLUTION 92-

SEDIMENT SCREENING CRITERIA AND TESTING REQUIREMENTS FOR
WETLAND CREATION AND UPLAND BENEFICIAL REUSE

Whereas, the California Regional Water Quality Control Board, San Francisco Bay Region (Regional Board) adopted and the State Water Resources Control Board (State Board) approved an amendment revising the Water Quality Control Plan for the San Francisco Bay Region (Basin Plan) in 1989 regarding disposal of dredged sediment; and

Whereas, the Regional Board in that Basin Plan amendment encourages land and ocean disposal alternatives whenever practical; and

Whereas, the Regional Board is an active participant in the development of the Long-Term Management Strategy (LTMS) for dredge sediment disposal in the San Francisco Bay Area; and

Whereas, the Regional Board developed the document entitled "Sediment Screening Criteria and Testing Requirements for Wetland Creation and Upland Beneficial Reuse" to assist the LTMS and individual project proponents to evaluate the feasibility of various beneficial reuse options; and

Whereas, the Regional Board circulated a notice of availability of the document for public review on September 18, 1992; and

Whereas, the Regional Board held a public hearing on October 21, 1992 and considered all evidence concerning this matter; and

Whereas, the Regional Board has determined that there are no State mandated local costs under Section 2231 of the of the Revenue and Taxation Code as a result of this resolution because such regulation is not an executive regulation by virtue of Section 2209 of the Revenue and Taxation Code; now

Therefore, be it resolved that:

1. The Regional Board adopts the guidelines set forth in the attached document titled

"Sediment Screening Criteria and Testing Requirements for Wetlands Creation and Upland Beneficial Reuse".

- 2. The State Board is requested to approve the proposed guidelines in accordance with Section 13245.5.**

I, Steven R. Ritchie, Executive Officer, do hereby certify the foregoing is a full, true, and correct copy of a resolution adopted by the California Regional Water Quality Control Board, San Francisco Bay Region, on October 21, 1992.

**Steven R. Ritchie
Executive Officer**

RESPONSE TO COMMENTS

SEDIMENT SCREENING CRITERIA AND TESTING REQUIREMENTS FOR WETLAND CREATION AND UPLAND BENEFICIAL REUSE

November 5, 1992

At the October 1992 meeting of the Regional Board, a document entitled Sediment Screening Criteria and Testing Requirements for Wetland Creation and Upland Beneficial Reuse was considered for use as a guidance document. Comments were solicited from interested persons through circulation. Numerous written comments were received in the days prior to the meeting; hence, staff requested that resolution of the document be held over for one month in order to review and consider the comments.

Below is a response to the comments received prior to the Board meeting and to a follow-up letter sent by the Army Corps of Engineers. In many cases the comments have been paraphrased by staff for brevity. The comment letters are attached.

GENERAL RESPONSE

Staff would like to thank all who commented on the proposed Criteria document. In all cases, the comments and questions posed were made in the interest of good science and environmental policy.

As with many proposed policy items, the comments can be grouped into three areas: 1) typographical errors and clarifications; 2) general policy or permit issues; 3) scientific or technical uncertainty.

The first type of comment is easily addressed: all errors brought to our attention will be corrected. Staff would like to thank the commenting parties for assisting us in the production of a professional document.

The second type of comment was pervasive in the comment letters and stems from both a genuine concern about regulation of wetland restoration projects and a lack of understanding of how this document "fits" with guidance documents and regulations from other state and federal programs. In revising the draft guidance document, we will attempt to clarify the discussion of how dredging projects are to be regulated by existing state programs, such as Title 23, Chapter 15 (Land Disposal) and Title 22 (Hazardous Waste).

It is important to stress that wetlands restoration projects will be required to obtain a permit from the Regional Water Board. Additionally, all sediment considered for wetlands restoration will already have been fully tested in accordance with existing guidelines issued by the US Army Corps of Engineers, US EPA, the Bay Conservation and Development District (BCDC) and the Regional Board(draft Public Notice 92-6). The

proposed guidelines are mainly intended to assist dredgers and project proponents in the scoping phase of their projects. The guidelines do not cover the myriad of issues which must be addressed by staff and the applicant during the permitting process. It is anticipated that the site permittee will be responsible for long-term monitoring and any resultant corrective action.

The third type of comment is by far the most challenging. This is the question of how existing data bases and studies are to be viewed and applied in a regulatory setting. Most of the comment letters express a concern that the documents used to establish the levels, as well as the methodology used to derive those levels is scientifically invalid or flawed. Staff are recommending to the Regional Board that existing studies (e.g., NOAA) can be used as guidance. However, it must be stressed that in no way does the implementation of this document preclude a more intensive or comprehensive field and laboratory effort which would result in data specific to the San Francisco Bay. Such work has been proposed and is being contracted through the Long Term Management Strategy (LTMS) process. We concur that this document is intended to be an interim step to facilitate wetland restoration and beneficial reuse projects.

SPECIFIC RESPONSES

Comment letters were received from the following parties. The comments are responded to by topic with reference to the number assigned to the letters.

1. League of Women Voters of the Bay Area, 10/18/92.
2. Contra Costa Water District, 10/8/92
3. U.S. Department of the Interior, Fish and Wildlife Service, 10/15/92.
4. Barbara Salzman (Marin Audubon Society), 10/12/92.
5. U.S. Army Corps of Engineers, Waterways Experiment Station (WES), 10/15/92.
6. U.S. Army Corps of Engineers, San Francisco District, 10/29/92.
7. RWQCB-Central Valley Region, Memo, 10/20/92.
8. G. Fred Lee and Associates, 10/18/92.
9. Levine-Fricke Engineering Consultants (Montezuma Wetlands Project), 10/9/92.
10. Port of Oakland, 10/8/92.

COMMENT: Sediment which is "dirty" will be allowed to be placed in North Bay wetlands causing a net degradation of water quality and/or the Bay's beneficial uses. (1, 4)

RESPONSE: The SWRCB has interpreted the Porter-Cologne Water Quality Act in Resolution 68-16 to prohibit the degradation of Waters of the State beyond existing or natural conditions. The Resolution states that "...existing high quality [water] will be maintained...". Staff will implement this policy in regulation of all wetland projects.

COMMENT: Tributyl tin and other anti-fouling compounds should be included in the criteria(2)

RESPONSE: Organotin compounds are included as analytes for testing of dredged sediment for any disposal option (US Army Corps of Engineers, Draft Public Notice 92-6). At this time there is insufficient information available to establish sediment screening criteria. When sufficient information becomes available, we will propose a numerical screening level for tributyl tin.

COMMENT: Further review and discussion of the methodology used to choose the screening levels is necessary. (2)

RESPONSE: The publications used to establish the levels are readily available and the methodology employed is explained in the text of the document.

COMMENT: The approach proposed by the Regional Board staff is technically invalid. (8) It is under-protective in some cases and overly-protective in others. (8) The approach does not adequately consider the complex nature of aquatic chemistry and the bio-availability of contaminants. (5,8). It does not consider the substantial technical literature that is available (8).

RESPONSE: This interim guidance document is to be used in the scoping phase of dredging projects and for examining various disposal alternatives. Sediments will also need to be evaluated with respect to the conditions contained in a given site permit. Permits contain provisions for long-term monitoring of the site as well as a Self-Monitoring program and are site-specific. The permit requirements will address in greater detail, the complex nature of estuarine sediment in that particular wetland environment.

COMMENT: Material to be used in levee restoration should held to the same testing requirements as wetland cover. (2)

RESPONSE: Staff concurs.

COMMENT: The leach test mentioned in the document needs further discussion and a method should be specified. The Board should consider the leach test developed at the COE's Waterways Experiment Station (WES). (2, 8, 9)

RESPONSE: Staff will recommend that methods such as the ones employed by WES be used for upcoming projects . However, because there has been no standard method developed (e.g. ASTM), staff will allow alternate leach testing methods to be proposed. The proposed flow chart will continue to include bioassay testing prior to leachate testing. This scheme is preferable to the having leachate testing prior to bioassay work because the existing 404 program testing guidelines (PN 92-6) already require that sediments be subject to toxicity testing.

COMMENT: Bioaccumulation testing should be required and the results compared to a reference site. DTPA should be considered for use as a model of plant bio-uptake. (3, 7)

RESPONSE: Bioaccumulation by plants and animals is a concern, however it is anticipated monitoring of contaminant uptake by plants and animals at a site will be done at the site. Long-term monitoring will be part of the Board's permit (i.e., Self-Monitoring Program).

- COMMENT: Mutagenicity testing should be considered for inclusion in the Criteria document. (3)
- RESPONSE: Mutagenicity testing will not be required at this time. A study through LTMS is exploring the feasibility of mutagenicity tests, as well as "biomarkers", and other sublethal effects. When this study is completed, this issue will be re-evaluated.
- COMMENT: The laboratory mesocosm approach to evaluating sediments for wetland restoration should be examined by the Board. (3)
- RESPONSE: The mesocosm approach, as recently used by WES, is intriguing in that it takes a more "holistic" approach than the standard laboratory bioassays. However, WES experienced considerable problems with carrying out these laboratory experiments. Staff are currently considering other approaches which are conducted in the field rather than laboratory.
- COMMENT: The document should remain flexible so as to reflect the results of new studies as they become available. For example the Fish and Wildlife Service is conducting studies of bioaccumulation of mercury in the South Bay which may merit some future change in the mercury criterion. (3, 6)
- RESPONSE: Staff will consider the results of new studies as they are made available and will revise the criteria as appropriate. Update of the criteria is discussed on page 5, second paragraph.
- COMMENT: Discussion of large vs. small projects is not presented clearly on page 4. (3)
- RESPONSE: The discussion of project size has been eliminated. The reference is in error and has been removed.
- COMMENT: The 10-day solid-phase bioassay using an amphipod may not be the most appropriate test for an intertidal environment. An intertidal amphipod or the mud shrimp *Callinassa* should be considered. (3, 5)
- RESPONSE: Staff will consider the addition of an intertidal organism after careful review of the literature. Currently dredgers are required to test their sediment using a 10-day solid-phase amphipod protocol. If a method using an intertidal organism is to be required, then the species employed should be comparable in sensitivity, cost and availability to the species currently required.
- COMMENT: Are other regulatory authorities in the Bay, namely BCDC, the Corps

and U.S. EPA developing similar guidance or frameworks for wetland and upland acceptability and is the procedure developed by the RWQCB compatible with theirs? (3)

RESPONSE: None of the agencies are developing similar guidance. However, those agencies are members of the LTMS. The LTMS workgroups and their contractors are reviewing the material acceptability guidelines and the regulatory framework for the reuse of dredged sediment.

COMMENT: How will the Criteria document be applied to innovative wetland restoration techniques, such as through "repeated deposition"? (3)

RESPONSE: The document is intended to apply only to "typical" scenarios. Staff will work on newer or more innovative approaches as they are proposed. Sediment used in a thin layer deposition approach would probably be compared to the wetland cover criteria.

COMMENT: Table 1 selenium value in error? (3)

RESPONSE: Corrected.

COMMENT: Will the same criteria be applied to all types of wetlands (i.e., brackish vs tidal salt)? (3,7)

RESPONSE: The document is meant to apply to all estuarine environments within this Regional Boards' jurisdiction (i.e., as far east as Pittsburg). The draft guidelines do not take into account impacts of saline leachate in a fresh water environment.

In the case of delta levees where receiving waters are fresh, the Regional Board may require that the salt leaching potential be monitored and/or controlled. This would be accomplished through the permitting process. Saline sediments could also be treated (washed) prior to placement on levees.

COMMENT: Sediment texture and organic carbon should be included because those factors determine wetland plant growth rates and the overall success of the restoration project. (3, 4)

RESPONSE: Staff agree that sediment texture, carbon content, as well as other factors strongly influence the overall health of marsh biota. Consideration of these factors will be part of the permitting process.

COMMENT: For marsh restoration projects, three feet of cover may not be sufficient to isolate non-cover sediments. (4, 9)

RESPONSE: Staff agree that in some cases more than three feet of cover will be required. Three feet of soil of appropriate texture and organic content should be adequate as a minimum cover thickness. Cover thickness will also be regulated by site permits.

COMMENT: It is not clear how a reference marsh site will be compared to the project site. Reference area soils may be very different chemically than the sediments under consideration for placement at a marsh restoration site. (3, 4, 9)

RESPONSE: Differences will be considered an indication that the sediment may not be appropriate for wetlands restoration. An evaluation of the test results and site conditions will determine the acceptability of dredged sediment.

COMMENT: Dredged material should be separated from hazardous waste. (5)

RESPONSE: Staff agree that dredged sediment is not a "listed" hazardous waste, pursuant to 40CFR; however, some Bay Area sediments may meet the criteria of a hazardous waste (Title 22 of the California Code of Regulations) and therefore would need to be disposed of at an appropriate hazardous waste facility.

COMMENT: Disposal inside and outside navigable waters (federal waters) should be separated from disposal upland outside that jurisdiction. (5)

RESPONSE: California law and regulation of landfills (Chapter 15, CCR) does regulate waste placed into waters of the state. The State regulates both surface water and groundwater while waters of the United States does not include groundwater. Under California law, disposal upland where groundwater is involved is regulated under the same laws and regulations.

COMMENT: Reconditioning of dredged material should be included in the proposed flow chart.

RESPONSE: We have revised the document to reflect this comment.

COMMENT: The use of total organic carbon criterion (TOC) needs to be justified. (5,8)

RESPONSE: The TOC criterion will be deleted.

COMMENT: Relevant portions of the USACOE/USEPA document entitled "A Framework for Evaluating Environmental Acceptability of Dredged Material Management Alternatives" should be included in the

Criteria document. (6)

- COMMENT: Staff have met with USACOE staff and have agreed to make changes to the Criteria document where appropriate to reflect the comment.
- COMMENT: The Criteria document should address the potential of sediments to become acidic (acid generation). Such acidification has been observed in Bay Area marshlands. Acidification of the sediment is probably caused by the decomposition of organic matter which in-turn produces hydrogen sulfide. The oxidation of sulfide to sulphate can reduce the porewater pH to toxic levels. (7)
- RESPONSE: Testing for sulfide is already required under the in-bay testing guidelines (PN 92-6) and pH will likely be one of several conditions checked by the owner/operator under their site permit. Acidification would be monitored and could be mitigated through treatment.
- COMMENT: The Regional Board should appoint an advisory committee consisting of experts who would work Board staff in the development of technically sound approaches for assessing whether sediments from a particular location should be placed in a wetlands environment. (8)
- RESPONSE: The LTMS has formed various workgroups to evaluate approaches to dredged sediment management. Various expertises are represented on the workgroups. The workgroup reviews the scope of services and products developed by contractors. Members of the workgroup have been given the opportunity to review the document.
- COMMENT: Typographic errors on page 5. (8)
- RESPONSE: Noted.
- COMMENT: Instead of implementing the proposed Criteria, the Board should "adopt a site-specific evaluation protocol..". "Basically, a site-specific hazard assessment/evaluation needs to be conducted...". (8)
- RESPONSE: Site-specific studies will be required of the site owner/operator during the permitting process. It is not practical to require a ecological risk assessment for every dredging project. The screening criteria represent a preliminary step in screening options for dredged material disposal.
- COMMENT: "NOAA values incorporate significant technical deficiencies. The manner in which those NOAA values were developed renders them inappropriate, and unreliable, for regulatory or even screening purposes." (8)

wetland restoration site permits.

COMMENT: ER-L and ER-M values are based upon flawed science and should not be used for screening purposes. (8)

RESPONSE: Comment noted.

COMMENT: "[T]he non-cover screening level criteria for chromium is extremely conservative for the non-hexavalent states." The level is overly protective because almost all chromium found in Bay sediments is in the trivalent state. (10)

RESPONSE: We agree that the chromium levels proposed for wetlands restoration may be overly conservative. Site-specific leach testing of the candidate sediments will be reviewed for upcoming projects and the allowable non-cover chromium level may be raised in cases where it is shown that the material contains naturally occurring chromium.

These comments were prepared by Tom Gandesbery and Michael Carlin of the Regional Board staff. For further information, please contact Tom Gandesbery at (510) 286-0841.

Attachment

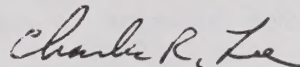
:comment/trg

9 Oct 1992

MEMORANDUM FOR Mr. Tom Wakeman

SUBJECT: Review of "Sediment Screening Criteria and Testing Requirements for Wetland Creation and Upland Beneficial Reuse" by California Regional Water Quality Control Board.

1. I received a copy of the Notice of Public Hearing for the subject above on 8 October 1992. The response date was set for 9 October. The Corps should submit written comments. My comments will be brief. A request for an extension of the submittal date of seven days would be appropriate to prepare more detailed comments and more constructive suggestions on how to improve the approach of the screening procedures.
2. The document has over-simplified the evaluation of the potential use of dredged material for wetland creation or upland reuse. It appears as though many bits and pieces of information were thrown together and not thoroughly thought out. I will try to point out some of these issues that require additional work and clarification.
3. Wetland evaluations need to be separated from upland evaluations. The present document only allows upland reuse (levee maintenance, landfill cover, etc.) if the dredged material has concentrations less than wetland cover concentrations and less than 5% TOC. All other dredged material is essentially tested for Class 1, Class 2, and Class 3 landfills. This is extremely shortsighted and does not consider the reconditioning of dredged material for upland reuse options. A list of upland tests were presented in the Section 2. Approach, but is not incorporated in the flow diagram for testing and evaluation. Upland testing as described in Section 2. Approach and reconditioning of dredged material need to be incorporated in Figure 4.
4. The wetland evaluation also needs to have the potential of reconditioning the dredged material to make the material suitable for wetland cover or non-cover material, if initially the screening cover criteria are not met.
5. The wetland leach test may give some indication of leachable contaminants in tidal waters initially, but does not address the longer term leaching from materials placed in an intertidal wetland environment. There are leachate tests described by Lee et al. 1991 that will give a better indication of this.
6. The document is a good start, but has a long way to go to set appropriate sediment screening criteria. These criteria will essentially indicate that there is or is not a reason to believe the dredged material is contaminated and the need to further testing and evaluation. That additional testing and evaluation should be consistent with that described by Lee et al. 1991 and Lee et al. 1992.



Charles R. Lee, PhD, CPSS
Soil Scientist

CF: Rod Chisholm, SPN-ER
Bob Engler, WES-EEDP

COMMENTS FOR PUBLIC HEARING REGARDING

"Sediment Screening Criteria and Testing Requirements
for Wetland Creation and Upland Beneficial Reuse"
Proposed by California Regional Water Quality Control Board.

1. I am Dick Lee from Waterways Experiment Station, Vicksburg, MS and represent the U.S. Army Corps of Engineers. Written comments have been submitted from the San Francisco District of the Corps. I will briefly highlight these comments.
2. The document, as written, has over-simplified the evaluation of the potential use of dredged material for wetland creation or upland reuse. It appears as though many bits and pieces of information were thrown together and not thoroughly thought out. Consequently, the document confuses many issues.
3. Dredged material needs to be separated from hazardous waste. The Corps and EPA have developed a framework for evaluating management alternatives for placement of dredged material in aquatic, wetland, and upland environments. This framework is based on 20 years of research and more than 50 million dollars of taxpayers' money. Take advantage of this wealth of knowledge.
This framework has been submitted with the Corps written comments. This technical framework is more appropriate and should replace or be incorporated into Figure 4.
The Corps/EPA framework will manage all dredged material that impacts waters of the U.S. under Section 103 of the Ocean Dumping Act and Section 404 of the Clean Water Act.
4. Wetland evaluations need to be separated from upland evaluations. The present document only allows upland reuse (levee maintenance, landfill cover, etc.) if the dredged material has concentrations less than wetland cover concentrations and less than 5% TOC. All other dredged material is essentially tested for Class 1, Class 2, and Class 3 landfills. This is extremely shortsighted and does not consider the reconditioning of dredged material for upland reuse options.
5. The wetland evaluation also needs to have the potential of reconditioning the dredged material to make the material suitable for wetland cover or non-cover material, if initially the screening cover criteria are not met.
6. I have drafted a revised Figure 4 that attempts to incorporate these comments for your consideration.
7. The bioassay test referenced is an aquatic amphipod test that may not be appropriate for wetland conditions, especially intertidal wetlands. A more appropriate animal such as an intertidal amphipod (*Corophium* sp.) or a mud shrimp (*Callinassa* sp.) should be considered.
8. The document is a start, but has a long way to go to set appropriate sediment screening criteria.
9. The San Francisco District has just finished two major, comprehensive studies of aquatic, wetland and upland evaluation of dredged material from Oakland Harbor and the J.F. Baldwin Ship Channel. These data should be used to assist in developing guidance for wetland and upland management alternatives for this region. Data such as this only exists in one other location in the world, in Connecticut, at the Corps/EPA FVP sites.
10. Last but not least, the Corps and EPA will be conducting a seminar on Dredged Material Management in South San Francisco on 17-19 November 1992 at the Crown Sterling Suites Hotel, Gateway Blvd. The framework will be discussed in detail, with testing and interpretation of test results. No cost to Attendees. Everyone here is invited. For more information, see me or other Corps members.

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